The Welding Engineer

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Founded by L. B. Mackenzie, 1916

WITH WHICH IS COMBINED ACETYLENE JOURNAL

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JUNE, 1931 | VOL. 16, NO. 6

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CONTENTS

Field Welding Secondary Beams 27
Commercial Aircraft and Welding 31
By Charles Froesch
Getting Production on Welded Parts 35
By Fred Anderson
The A. W. S. Structural Welding Code 39
B. H. H. Moss
Some Resistance Welding Problems 42
By C. L. Pfeiffer
Hints for the Welder 47
Editorial 25
Training Welders in the School 37
By C. D. Moore
A Welded Dwelling House 40
Building a Job Welding Business 49
By W. Irving Brockson
Interesting Repair Jobs from the California Oil Fields 44
By W. E. Archer
Welded Steam Coil for Heating Crude Oil 45
Weld Pipe Fittings Right on the Job 51
By Fred S. Durham
Events and News of Interest 54
New Literature 56
New Products 58
News of the Industry 59

Who Pays the Advertising Bill?

A MESSAGE prepared for the public by the Bureau of Research and Education of the Advertising Federation of America, under the title, "Who Pays America's Two Billion Dollar Advertising Bill?" presents some very interesting economic facts about advertising. Under the subject of "The Influence of Advertising on Prices," the message says in part,

"The average price of groups of commodities affected by advertising has increased by 10% from 1913 to 1930.

"During the same period all commodities combined, including both advertised and unadvertised goods, have gone up in price by 20%.

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"We must not conclude from this that advertising alone actually causes prices to be lowered, for advertising is only one of the many factors which influence price.

"The parallel conclusion, however, seems fully justified, and that is that advertising does not tend to increase the price."

The consumer undoubtedly pays the advertising bill, but it is a good investment for him, because the total sales cost is lowered by an amount greater than the amount chargeable to advertising. This is substantiated in the article mentioned above by records which show that while the total volume of advertising expenditures has increased, its percentage of the total expense has steadily decreased.

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The Welding Engineer does not publish in its news or advertising columns any matter that deals with or refers to either personal or legal controversies.

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Readers of The Welding Engineer will find this index to contain the most accurate information obtainable relating to welding apparatus and supplies. The advertising section includes the principal manufacturers of the United States.

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EDITORIAL

Tubular Shapes Are Getting More Recognition

ITEMS have appeared in recent issues of several business publications of general circulation, commenting on the growing use of tubular shapes in Germany, particularly in building construction with special mention made of their use in the construction of trusses and the fact that these assemblies are made by welding. The advantages of the tubular shapes for many types of structures has been well-known to engineers in this country for a long time; but the line of least resistance has been followed in a good many cases, because tube forms do not lend themselves readily to riveted assemblies, and riveted assemblies are at the present time strongly favored because engineers know more about how to put them together. Improvements, however, are being made in the field of tube manufacture, and this is going to cause the tube manufacturers to look for larger markets for their products. It is to be expected that they will in due course lend a hand effectively in developing this attractive field for the application of fusion welding.

The Trend in Process Plant Equipment

A SURVEY based on questionnaires sent to a large number of manufacturers in the fields of chemical engineering and allied equipment, and reported in a recent issue of Chemical and Metallurgical Engineering, shows remarkable progress made by the welding processes in this field during the past three years. "Welding appears to have gained ground in more than a quarter of the cases," says the report. "A truly remarkable showing, in view of its comparative newness. In those cases where its use is most logical, its progress is even more remarkable. It has been employed as an improvement during the three year period by 100 per cent of the crystallizer manufacturers reporting, with percentages as follows in other cases: Dryers, 75; condensers and heat exchangers, 73; evaporators, 69; tanks, 54; kettles, 50; stills and fractionating equipment, 46; builders, 45; powers, 43; and mixers, 40." Here is a field where much of the equipment is built for the most exacting service, and within three years more than 50 per cent of the output has been improved through the use of the welding processes.

Safety in Numbers

THERE is an old saying that there is safety in numbers. This is illustrated in a peculiar way in the study of accidents made by the Department of Labor and Industry in the State of Pennsylvania. The department prepared a chart showing the accident frequency rates per one hundred employees according to the size of the establishment, and this chart has been analyzed in an interesting manner in a pamphlet prepared by the Metropolitan Life Insurance Company. An analysis points out that in general all large plants or companies have lower frequency rates than small plants or companies. However, it has been found that not all small plants have poor accident experiences and that this factor can be controlled effectively in the small plant when the right kind of safety work is conducted. Safety work has, in fact, required the expenditure of large sums and has engaged the attention of hundreds of very capable engineers. In spite of this, it seems to be difficult to determine just how much progress has actually been made in accident prevention. The reason for this probably is that most of the safety work has been done by the larger companies, who take these sources of loss more seriously. One large plant in the Chicago district operated over 400 days without a time-out accident. The small company does not need a safety engineer and a large safety committee. However, it does need a disposition on the part of the management to establish safe practices and to keep employees informed on the possible results of avoidable accidents which cannot be covered by insurance.

New Equipment As a Cure for Unemployment

EVERY industry and every line of activity seems to have its own solution for the unemployment situation. The manufacturers ask the retailers to stock more merchandise so as to keep factories going and keep payrolls up, thus maintaining purchasing power. Some public organizations recommend steady buying, but not overbuying. An interesting suggestion was made by Carl A. Johnson, president of the National Machine Tool Builders Association, in a talk which was broadcasted on April 26th. He pointed out that 48 per cent of all metal working machinery in this country is over ten years old, and stated that it cost more to use an obsolete machine than it cost to buy a new one. He suggests, therefore, that a works manager should not have to ask his employers to furnish new machinery, but that, on the contrary, the pressure for the replacement of out-of-date machinery should come from the management down and not from the works up. He stated that if the works manager could be required to prove that any machine over ten years old can still be profitably used, some startling leakages in money would be disclosed in almost every plant. In other words, American manufacturers have a very definite excuse for doing some buying themselves which would finally result in more buying being done by consumers on account of the natural increase in the payrolls.

Theory and Practice Should Work Together

AMONG the many comments on various phases of welding instruction, it is interesting to note the following extract from a letter received at the close of last month:

"It is rather a surprise to know that so many of the schools think so little of using what has come from welding research. There is no one man who can instruct and lecture from his own mental capacity so well that his students will be able to absorb the best part of welding theory. My own experience in welding up until a year ago was limited wholly to the practical side. I had been able to fuse steel, cast iron and aluminum without a single failure and without the knowledge of the why and wherefore. When it became necessary to start teaching, the value of theory became apparent, and we recognized it. We are not relying on any one authority for our instruction. We find the various authorities all brought together between the covers of *The Welding Encyclopedia* and *The Welding Engineer*, and these certainly are dependable sources of information; so with all due respect to practice, the study of the theory is enabling us to add to our practice work the knowledge of what it is all about, the knowledge of what we put into the weld, of what we are welding and how we are doing it. Theory is the propelling power and practice is a matter of putting quality into the work. They are both necessary to the instructor."

This comment comes from an instructor in a welding school which is widely known for the high quality of its work and the unusual ability of its graduates. There is no doubt but what this instructor is right, especially if welding instruction is to be carried on for the purpose of developing operators who really know what they are doing.

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Field Welding Secondary Beams

Prominent Authorities on Structural Welding Discuss Methods of Assembly When Secondary Beams Are Shipped Direct to the Building Site

IN connection with the welding of steel building frames, a question has several times been raised regarding the advisability of shipping secondary beams direct to the building site in order to save extra handling. This question has been referred by the editors to several authorities in the industry whose replies are given below, together with a number of illustrations of practices which have been found successful.—Editor.

* * *

A. G. Bissell,
Consulting Engineer,
Seattle, Wash.

It is quite certain that secondary beams can be delivered to a building site directly from the mill at a price lower than if the same beams were delivered through a fabricating shop. If there are not many connecting angles required to be welded on, the cost of these beams fabricated will still be less if the welding is done in the field than if the beams had been fabricated in the shop. However, field welding in most cases costs much more per foot than shop welding and the difference in the cost of field and shop welding on a job where an extensive amount of welding is required may more than offset the saving made by direct shipment of the secondary beams.

Location also will have its influence. On the Pacific Slope, field ground work is quite practical owing to the fact that work can progress in the open with little or no retardation due to unfavorable weather conditions. In other parts of the country protection from and delays due to rain, snow, heat and cold must be considered with the resulting increase in operating costs.

It is the writer's belief that the question of where the secondary beams should be fabricated will depend entirely upon the location of the site, weather conditions, amount of welding and available ground space for each individual job in question. A mill type building in an industrial district would offer ideal conditions for ground work while none at all could be done on a multistory building in a business area.

However, the development of field shop organization whereby field ground work will be handled with the same dispatch and system as an inside shop is recommended. In this way field ground work may be reduced to the lowest possible cost per foot of welding and used to an advantage wherever space permitted its use.

* * *

A. M. Candy,
Engineer, Welding, Eng.,
Westinghouse Electric & Mfg. Co.

Both in the case of our Central Engineering Laboratory building at East Pittsburgh (Fig. 1) which involves a total tonnage of steel in excess of 2,000 and the Service and Warehouse building at our Newark Works (Fig. 2) which involves almost 1,100 tons of steel, the secondary beams, namely floor beams heading into girders, were shipped direct from mill to site with the usual mill tolerance as to length, namely plus or minus $\frac{1}{8}$". These beams did not have any holes in their flanges and no connection angles as such were used in securing them to the girders. There were provided however seat angles on the girders at the proper locations on which the beams were mounted in position during erection and to secure them in position on these seat angles wedges were driven between the face of the top flange of the floor beam and the underside of the top flange of the girder. This appeals to me as being about the simplest form of construction which will permit of rapid erection work. At the present time I do not see how the seat angles, or in some particular cases their equivalent in the form of spacer blocks, could be eliminated and at the same time have the erection work proceed at the required speed. The reason I am mentioning this point

Figure 1. Installation of Floor Beams in Westinghouse Laboratory at East Pittsburgh.

is because some people have been quite emphatic in their expressed desires to see a building erected without any holes and without the use of connecting angles. I for one question seriously just how far such ideas could be carried out and at the same time provide for erecting the steel at a rate comparable with that which can be carried out in riveted construction. It would be possible of course to erect a building almost entirely without the use of any connecting angles at any point. However, the amount of labor involved in erecting the steel and plumbing it while the various members were being welded in position would result in such expensive construction work that it would be economically out of the picture.

* * *

Carl H. Sørensen,
Engineer,
The Leake and Nelson Co.

The question, "Is it practical on a welded building, to ship the secondary beams to the job direct from the mill without any shop fabrication?" can best be answered by stating that it is not only practical, but has been successfully done on a number of buildings. This is one of the reasons, why a welded building compares favorably as to cost with a riveted building.

Of all the large welded buildings which we have welded, only one, which was shop riveted and only field welded, did not have all the secondary beams shipped direct from the mill. In some cases even the girders were shipped to the building site without shop fabrication, and all fabrication of these girders done in the field.

In general it is not necessary to frame the secondary beams

to the girders with the top flush, and it is then possible, by using the CB beams which have parallel flanges, to design the steel so the girders are only two inches deeper than the secondary beams, and the secondary beams can then rest on the bottom flanges of the girders, and can be erected without use of erection bolts. After they are erected they can be

Figure 2. Floor Beams on Seat Angles with Wedged Blocks Driven in Position.

welded together at the bottom flanges, and at the top with a plate; or if the reaction is too great for the bottom flanges to carry, a single angle can be welded to the web of the girder, and to the web of the secondary beam. This detail is shown at Fig. 3. If the depth of the beams are such, that this detail cannot be used, either a filler plate can be welded to the bottom flanges to raise the beam, as shown at Fig. 4, or an angle can be welded to the web of the girder to form a seat angle, these details are shown at Fig. 5 and Fig. 6. When the beams are only to carry a suspended ceiling, the detail shown at Fig. 7 can be used.

In regard to the girders, it is in many cases better to ship them direct to the building without any shop fabrication, all the connecting angles for the secondary beams can be welded on cheaper in the field, and the holes in the ends of the girders, which are used only for erection and plumbing up, and do not transfer any stresses, can be burned in the field. In this way only the columns and any beams with special framing, need to be fabricated in the shop before shipping.

As to erecting the secondary beams without the use of erection bolts, we have found no trouble there, in fact we would rather erect them this way, because it is both cheaper and takes less time than otherwise.

* * *

J. C. Lincoln,
Lincoln Electric Co.

In a general way it would seem to me that these beams could be delivered directly from the mill to the job, cut to length, and the supporting angles welded to the I-beams so that the secondary beams could be put directly into place.

With the advent of the new type of electrodes giving a ductile weld metal and high speed of deposit, I would expect that the art would grow in the direction of welding the supporting angles in the field rather than in the shop because in many cases it seems to me it would be cheaper to do the welding in the field rather than pay for the extra transportation between the structural shop and the work which is necessary when any work is done in the shop.

The present practice is to ship steel from the mill to the structural shop, have work done on the steel at the structural shop then ship the steel from the structural shop to the job or as directed. When steel is erected by the riveting process this double shipment of material is necessary. I shall be surprised if the use of the welding process in a few years does not make it possible to ship a great deal of the material from the mill directly to the job without going thru the structural shop at all.

I would expect as the Welding Fraternity becomes more accustomed to the erection of steel buildings, the tendency will become more and more to ship the steel, cut to length, from the mill direct to the job and have it erected by means of welding in place.

* * *

E. H. Ewertz,
Consulting Engineer,
New York City.

Devising a method permitting placing in position on a structure secondary beams with lengths cut to the standard rolling mill plus or minus tolerance and shipped direct to

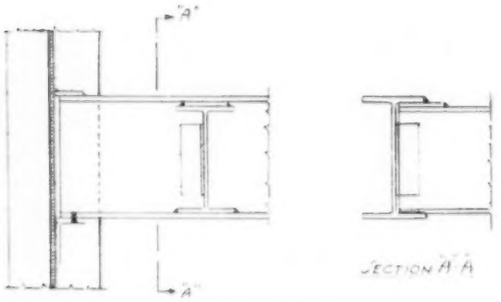


FIGURE 3

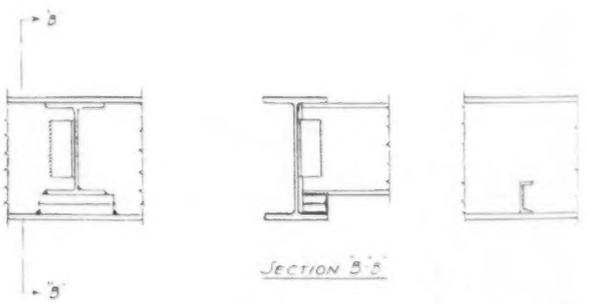


FIGURE 4

FIGURE 7

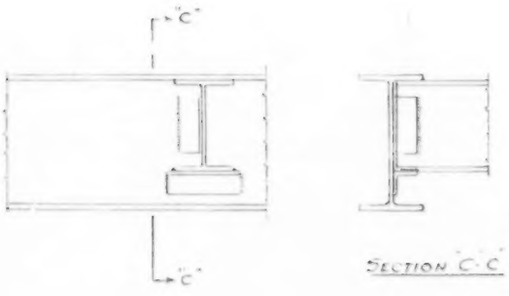


FIGURE 5

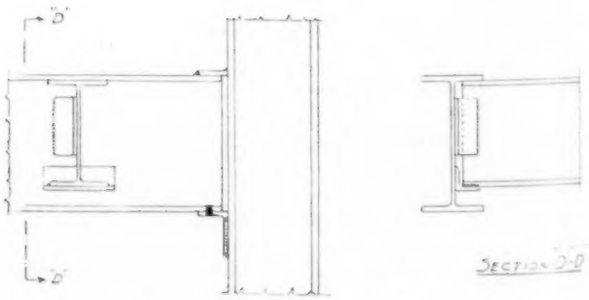


FIGURE 6

probably been given more thoughtful consideration by structural engineers than any other detail of a welded structural design.

At times engineers less directly interested in a subject can offer solutions to problems, even though modification of the original solution is essential to permit its proper application.

Certain structural members, like columns, generally require some shop work and while in shop modified forms of angle seats might be attached to columns of such form as to permit handling of column in usual manner without exposing the special form seat to damage during handling or shipping.

Then again, holes may be so drilled or punched in the main members as to allow insertion of a special form bolt and nut or bar and sleeve so placed that the secondary beam may be hung (not sit) on such a support.

Once the beam is held in a safe position the under support (if not already there) and the upper connection may be welded in place and the temporary support removed.

* * *

Gilbert D. Fish,
Consulting Structural Engineer,
Westinghouse Electric & Mfg. Co.

In small buildings it is not only possible but frequently convenient and economical to ship all steel except columns and connection pieces directly from rolling mill to building site, thus eliminating shop work from 60% or even 80% of the total steel. This procedure generally requires some welding of angles or other connection pieces to members before erection, and therefore requires some work done on the ground within or adjoining the building.

In multi-story buildings, especially in crowded city districts, preliminary work on members before erection is undesirable and therefore, the shop fabrication is usually carried further. Even in such jobs, intermediate or secondary beams may be erected without preliminary work and simply welded to seat angles on the girders. In the future of welded building construction, I expect it will be usual to ship secondary or "fill-in" beams plain, and I expect that the use of clamps or other devices in place of erection bolts will eliminate punching and a large amount of other fabrication, which is necessary or customary in preparation for riveted connections.

In one case arising in my practise, a building over one hundred feet high was erected with the aid of clamps, using no erection bolts at all, except two bolts at each column splice.

* * *

Frank P. McKibben,
Consulting Engineer,
Black Gap, Pa.

It is possible to design connections of secondary to main beams in such a manner as to eliminate from the secondary beams all fabricating shop operations, and thus permit shipment directly from the rolling mill to the building site. The problem is, however, not merely one of eliminating connecting angles from, and all punching of holes in the secondary beams, but provision must be made in most structures for holding these beams in place during erection, because if a beam be set on a bracket angle or shelf and be not held there it may be knocked off, possibly resulting in considerable damage.

Where possible and desirable to affect this economy it can be accomplished by resting the secondary beam on a bracket angle attached to the main beam, and held there during erection in either of two ways:

a. By hook bolts passing through the outstanding leg of the bracket and hooked around each bottom flange, Figure 8. The bottom flange is then welded in the field to the outstanding leg of the bracket. This method was used in 1928 at Building 36, Pittsfield Works, General Electric Company, where 18″ secondary floor beams were shipped directly from rolling mill to Pittsfield and connected to rolled floor 27″ main girders with two hook bolts at each end of each secondary beam. After the secondary beams were thus placed they were field welded to the outstanding leg of the bracket angle. A few beams were also placed and welded without the use of hook bolts.

b. The desired result can be accomplished by shipping the secondary beam to the building site and there welding

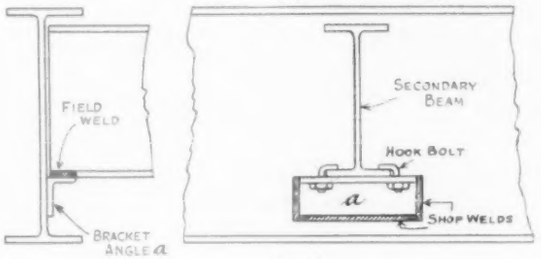


FIG. 8

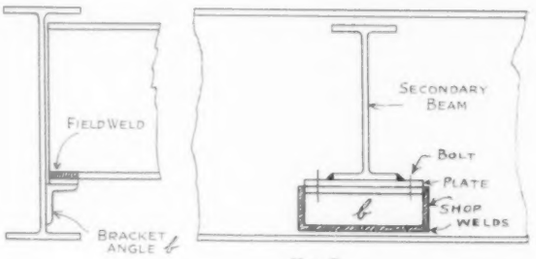


FIG. 9

to each end of its lower flange a small plate with two bolt holes to match holes in the outstanding leg of the bracket angle. Figure 9. After thus bolting the beam in place it may or may not be welded to the bracket angle as the nature of the building demands.

In either of the two methods above outlined the end shear of the secondary beam is transferred to the main beam by a bracket angle, a, Figure 8, subjected to shear and bending. The angle may be welded along each end and along the lower edge. The maximum stress in this bracket is compression and occurs in the face of the vertical leg of the angle at the beginning of the fillet. But the maximum tension is really the controlling feature and generally occurs at the back side of the vertical angle leg opposite the beginning of the fillet. Often it is possible to use a bending moment equal to one inch times the end shear of the secondary beam and apply this moment to a section the breadth and depth of which are the length and thickness respectively of the bracket angle leg. The maximum fibre stress should not exceed the allowable, 16,000 or 18,000 lbs. sq. in. as specified by the building code.

The theory of this bracket angle is interesting. As the beam deflects under its load, its end assumes a slope which tends to throw the resultant pressure at or near the outstanding leg of the bracket. This deflects or bends the bracket and moves the point of application of the resultant nearer the back of the bracket angle. One method of solution is to equate two expressions, one representing the slope of the bracket leg as a cantilever, the other representing the slope of the end of secondary beam; solve the equation for the point of application of the resultant pressure and then compute the moment. But welding the beam to the bracket upsets this theory and gives the bracket much greater strength.

Furthermore, where a beam rests on a short bearing seat it is necessary to examine the buckling in the web of the beam and in some cases to stiffen the web over the bearing by welding a flat bar to the web. The necessity for this stiffening does not occur frequently. In the nineteen story Dallas

Power and Light Company's welded building some of the main rolled girders were thus strengthened.

Where the main beams are designed under the assumption that their compression flanges are braced laterally it may be necessary to field weld the secondary beams to the main beam at or near the latter's upper flange, unless the floor construction is such to serve as lateral support.

And of course if the secondary beams are designed as continuous beams there would be welding at intersection of main and secondary beams at or near their upper flanges.

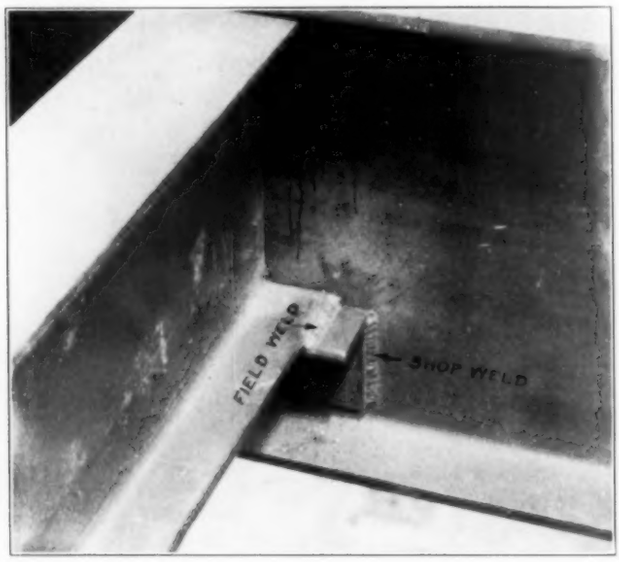


Figure 10. Bracket Angle Is Shop Welded to Main Beam with a Field Weld Connecting the Secondary Beam. Neither Hook-Bolts Nor Erection Bolts Were Necessary.

The above method of supporting beams requires no alteration of rolling mill practice as the beams are shipped with their usual mill tolerances. It should be remembered that in erecting a beam with hook bolts or no bolts at all to serve as anchors, the mill tolerance or clearance may be accumulated at one end of the beam and thus tend to increase the bending moment in outstanding leg of bracket.

* * *

H. M. Priest,
Assistant Engineer,
American Bridge Co.

If shop fabrication is eliminated, it is also essential that field fabrication for these intermediate beams be avoided. In other words, the plain beams should be set in their final positions just as they come from the mills. The only practical method of doing this is to support the ends of the beams in bearing rather than through shear connections on the webs. When the girder flanges are of sufficient strength the secondary beams may rest on the bottom flange. In other cases, it may be possible to weld seat angles on the girder webs. The engineer should endeavor to select sizes of beams and girders which permit one or the other of these two details to be followed.

The question of holding the secondary beams in place until welded to the seat angles or girder flanges has been handled in two ways and depends upon the erector. One way has been to drive a plate between the top flange of the beam and the under side of the girder top flange, this plate acting as a sort of wedge. The other alternative is to leave the beams without temporary restraint, in which case the erector must use extra care not to accidentally displace the beams.

The problem of shipping the secondary beams direct from the mill appears to be a fairly simple one when it is possible to select the sizes with a view to meeting the conditions already stated.

Battledeck Floor Tests

The present status of the Battledeck Floor tests at the Bureau of Standards is as follows:

The Uniform Live Load Test has been run and, due to a great press of urgent work, Dr. Whittemore, Chief of the Engineering Mechanics Section has been delayed in preparing the final draft of the report. The final report should be in our hands at an early date.

The first Fire Test of Battledeck Floor, which consisted of the application of fire from above on the bare steel plate with combustible materials equal to 10 pounds per square foot of floor surface, was run three weeks ago and we have in hand a preliminary report covering this test. This preliminary report does not, however, give the thermal couple readings in the steel which are being worked up at the present time.

The second Fire Test, also with fire from above, and consuming 10 pounds of combustible material per square foot, but with different conditions of restraint, was run on April 15 and the results are now being tabulated. The third Fire Test will be made early in May. The plate in the third test will be covered with one-quarter inch Battleship linoleum.—*Amnisteel.*

Simplify Handling with Traveling Gantry Crane and Luffing Boom

The crane shown in the illustration spans eighty feet of trackage and storage space. Its luffing boom, when horizontal for unloading of vessels, has an effective reach over the water of 44 feet. The view shows the luffing boom extended. The sulphur is removed from the steamers by a bucket of 3 cu. yd. capacity of Blaw-Knox Dreadnaught Type. The loaded bucket is lifted at a speed of 150 feet per minute, the holding line and closing line hoists being driven independently by two 80 H. P. motors. A maximum lift of the bucket of 34 feet above the dock floor affords a large storage capacity under the crane. The luffing room is raised into almost a vertical position to clear the ships while docking.

Bucket Extended Ready to Pick Up a Load.

The rated capacity of the crane is 7½ tons. Its overall height is 77 feet and its overall length with boom in horizontal position is 150 feet. An idea of the size may be obtained from the fact that The Cleveland Crane & Engineering Company, Wickliffe, Ohio, designers and builders, required fourteen cars to ship it. In erecting it all riveted field connections were afterward also arc-welded to insure permanent alignment and impart additional strength and rigidity to the structure. The trolley frame and operator's cage are of arc-welded, rolled steel construction.

Commercial Aircraft and Welding*

A Discussion of the Merits of the Welded Structure in Aircraft and Some Operating Factors Which Govern the Safety of the Job

By Charles Froesch†

IT IS but some odd 26 years ago that the Wright Brothers showed the world that man could fly and develop wings of usefulness. Since then a great many records have been made and have definitely established the reliability of the airplane as a vehicle of transportation as well as its freedom from mechanical trouble which was spectacularly shown by the refueling duration flights of Dale Jackson and Forrest O'Brien this year and last.

In the early period of flying developments were slow and often discouraging to those who had the perseverance, the courage and the profound belief of their conviction that air transportation would some day be a necessary part of our daily life as well as a most popular form of travel.

It remained for Colonel Lindbergh to fire popular enthusiasm in 1926 and begin a period of commercial air transportation which is gradually increasing in importance by rendering commercial services and creating problems for which we find no precedence in the world history of business.

Americans have a complex for speed. They like the swift transportation of themselves as well as their goods and since the airplane was first conceived in a practical way we have increased our flying speed approximately 15 miles per hour, per year and find that we can fly now at 350 miles per hour. No doubt it will not be long before we shall speak of 500 miles per hour more.

While such high speeds are not exactly within present commercial realization the lessons that are being learned from such experience have helped a great deal to improve the efficiency and reliability of the airplane as a vehicle of transportation.

We already have several great transcontinental airways which bring the two great oceans bordering our shores within 40 hours from one another. From these spread a network of feeder lines similar to the nerves of the human body which, starting from its great center, ramify to every part of its limbs. Tomorrow, with better and larger airplanes powered with more reliable and bigger engines, this network will, no doubt, be doubled in size.

Speed, which is the most important economic asset of the airplane, is gradually making it a necessary supplement to existing means of surface transportation wherever available today.

But all these wonderful things could not have been achieved without the genius of the inventor, the brains of the designing engineer and the modern methods of precision and manufacture. To this end the members of this association and companies affiliated with it have contributed a great deal to its success because welding is a most widely applied process to all aircraft construction and parts manufacture.

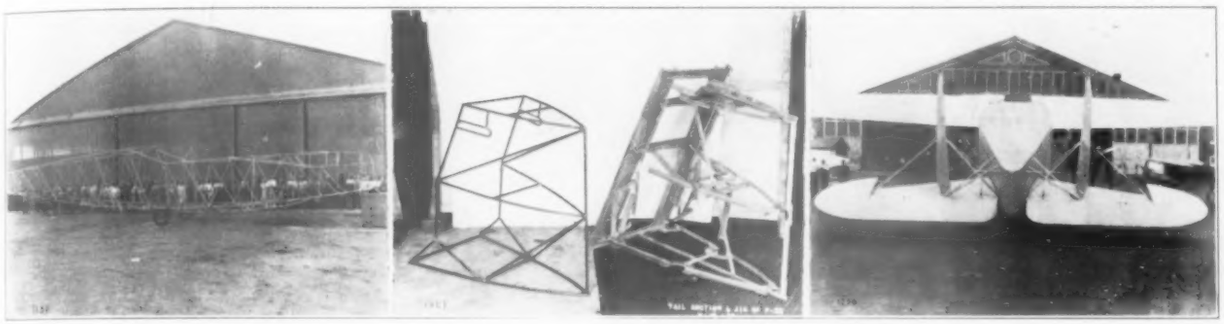


Figure 1. (Left) Welded Fuselage of a Huge Fokker F-32 Plane. Figure 2 (Center) Welded Fairing Which Is Mounted at End of Fuselage to Reduce Wind Resistance. It Is Shown Covered and in Place on the Plane in Figure 3.

To predict what the future will reveal would be rather presumptuous, but a comparison with past developments of various vehicles of transportation seems to indicate that their rate of growth is proportioned to their actual speed. For instance, it took 100 years for the railroads to reach their present state of perfection. The automobile, as we have it now, is but 35 years old while commercial air transportation is just beginning.

Airplane designers can be divided today into three schools, each following a somewhat different line of thought and details of construction. We have the adherents to all wood construction which are gradually disappearing. Next, those who specialize in all metal structures principally riveted strip steel or aluminum alloys, and finally the composite school which believes in all wooden wings and metal for the fuselage and remaining structural parts of the airplane. It is to the latter that Fokker belongs at present.

The use of wood for wing structures especially of the cantilever type permits lightness and resiliency and the dead beat qualities of the wood also serve to cushion sudden air loads acting at the same time as a vibration insulator between the engine nacelles and the passenger cabin in multi-engine airplanes. The welded steel tube fuselage and other structural parts combine both light weight and strength which are obviously necessary.

Conceived and developed by Fokker about 15 years ago, the steel tubing fuselage with welded joints has now become standard practice. Its advantages are universally recognized both on the score of safety and economy of maintenance. This has been proved by the many thousands of airplanes built by this method of construction and the many tens of thousands of hours of service. It may be of interest to mention its outstanding advantages.

1—By properly designing a welded structure of steel tubing

*Read before the 31st annual convention—International Acetylene Association, Chicago, Illinois—November 12, 13, 14, 1930.

†General Service Manager, Fokker Aircraft Corporation of America.

maximum resistance against collapse or mishap can be obtained.

2—Being completely sealed deterioration by oxidation due to time or the elements is completely eliminated.

3—Repairs to welded structures are not expensive; as a hacksaw, a file, a hammer and a portable welding outfit besides the tubing required is all that is necessary.

4—Inspection can be positive because cracks or defects can readily be detected.

5—Any mechanic can, in a few hours, be taught to weld sufficiently well to quickly make permanent repairs to this type of fuselage. Riveted construction requires high grade skill and equipment as inspection of the riveted bearing cannot be readily made and one must depend to a larger degree upon workmanship.

It may be of interest to note, while passing, that when a few old D-7 Fokker fighters so well known at the front during the late war were used several years ago in making the famous motion picture called "Wings" it was actually found necessary to saw off some of the structural tubes to permit crashing for the actual filming of this picture.

My knowledge of the welding art is entirely too limited for me to even discuss its minor technique especially to you who are well versed in this practice. Therefore, I shall confine myself to describing its application to the various components of the airplane.

Figure 1 shows the bare fuselage of the Fokker F-32 entirely built of welded steel tubing. An idea of its size can be obtained by comparing it with the workmen lined against the hangar doors in the background.

The tubing used in building up this structure ranges in size from ¾" diameter x .035 wall to 2¼" diameter x .120 wall. Over 1,000 individual welds were required to unite these tubes into a single unit.

It may be mentioned that wherever possible new welds are never made over old ones to eliminate any possibility of burning the material.

The fairing which is mounted at the tail end of the fuselage in order to complete its shape and reduce air resistance is shown in Figure 2. On the right is shown the welding fixture used in assembling the tubes of the tail fairing. This fixture is built up of angle iron channels spot welded together. This method of making temporary jigs is faster and inexpensive. The tube used in making up this fairing is very light, ¾" x .035.

Figure 3 shows the location of the fairing which is now covered and in place. Note the tail bracing which consists mostly of stream-line tubing with end fittings welded in place.

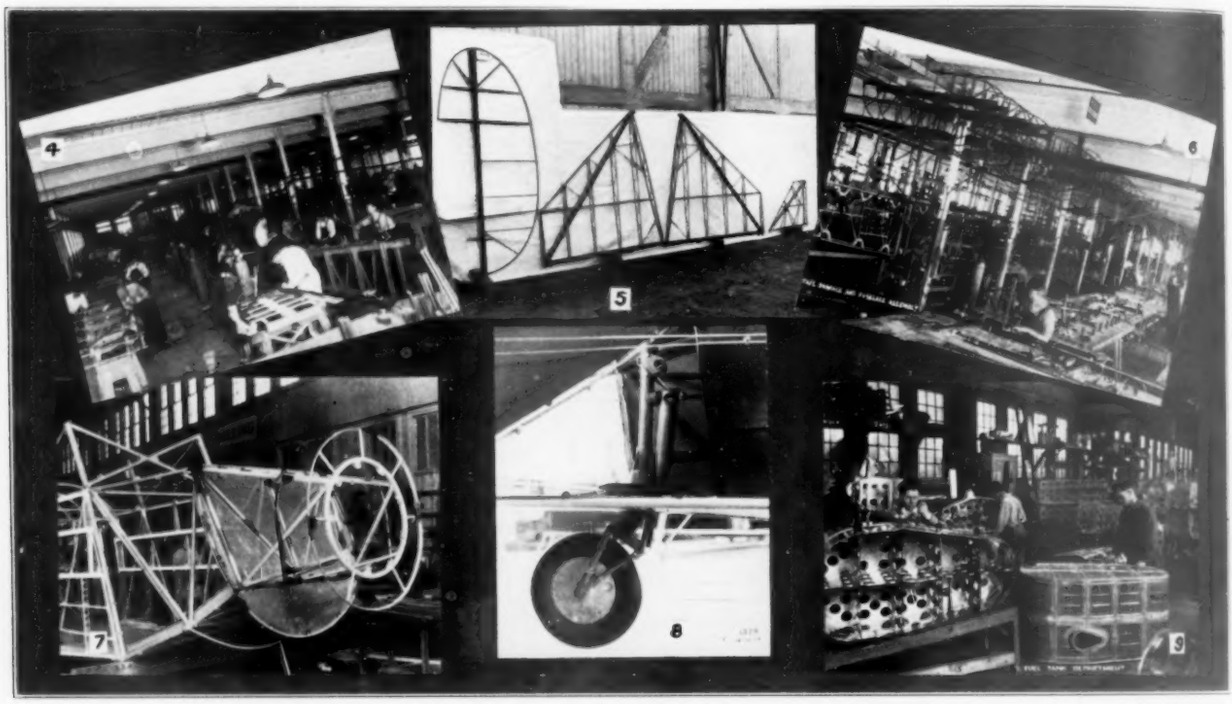


Figure 4. The Fuselage Construction Shop. Note the Wide Use of Jigs Which Are Used for Every Assembly and Detail of Construction. Figure 5. Complete Set of Tail Surfaces for a Tri-Motor—Rudder, Stabilizers and Fin. Figure 6. The Tail Surface Rudder Department. Figure 7. This Gives a Good Idea of the Intricate Construction of the Engine Mount. Figure 8. A Tail Wheel Assembly Mounted on the Ship. Figure 9. The Fuel Tank Department.

The design of these fittings is such that the welds are always in shear as tension loads are not considered good design and have very low strength weight ratio.

Figure 4 shows the fuselage construction shop with several fuselages on assembly jigs and sides being made on detailed jigs. Practically all jigs used in steel tubing construction are built up of structural steel or angle iron welded together in a way to allow ease of modification to suit design changes which are always numerous in the development stage of a new type.

Here in Figure 5 we have a complete set of tail surfaces of a trimotor. You will note that in each one of these frames —rudder on the left—stabilizers center and fin right—the backbone of the structure—consists of a heavy wall diameter tube known as the spar to which is welded ribs of very thin gauge tubing of small diameter to give it its shape and which takes the covering usually of cloth or aluminum alloy sheet. Great skill is required to weld the light weight steel tubing to the heavy spare so that a normal weld will be obtained between the two tubes without burning the small one.

Figure 6 shows the tail surface rudder department shop and the fuselage assembly jigs in the background.

Figure 7 is a closeup view of the engine mounting frame and support of a large single engine airplane. In the foreground at the front we see the engine ring with strut mounting lugs welded on to it and a very light frame supported

from this engine ring for holding the outside cowling. The cross type structure on top of the fuselage connects to the wing attachment fittings.

A tail wheel assembly mounted on the ship is illustrated in Fig. 8. The fork itself which holds the wheel is made up of a large center tube with the structure of small size tubes welded on to it thus forming a strong and rigid assembly. Note the tack welding at the top of the center post which holds the rubber shock absorber rings in place.

We show the construction and manufacture of fuel tanks in Figure 9. The tanks shown have a capacity of 180 gallons each and are made up of welded aluminum sheets. The weight of the complete tank is but 65 pounds, 1/3 of a pound per gallon capacity. Note the beads on the outside sheets to provide for expansion and contraction when welding the assembly together.

Figure 10 shows oil tanks in the process of manufacture. The construction of these tanks is somewhat different as being of smaller capacity, 15 to 20 gallons each, they consist of an outside shell oval in shape with end plates welded on to it. Note the cowling tubes which go through the assembly and are welded to each end plate. A center baffle located to prevent swashing of the oil within the tank is located in place in the middle by means of six lugs protruding through the tank shell and spot welded in place.

The steel tubing used in aircraft construction is either low carbon steel S.A.E. 1030 Specification or chrome molybdenum steel tubing. From the production viewpoint, the rapidity with which a welder works is the best proof of his skill as a real quick weld is a good weld and a slow weld is often poor because it either results in the material being burned or in irregularities of the surface.

The welding of carbon steel is a comparatively simple matter and more trouble has been experienced in the early days when aircraft manufacturers first began to use chrome molybdenum steel tubing. This was due to the lack of knowledge as to how tubes should be fitted before welding. It was found absolutely necessary to provide enough clearance between the tube to be welded and the structure so that expansion of the weld and the tubing itself would be insufficient to create an internal strain within the tube material itself as if this happens a permanent strain remains within the tube and failure due to cracking or splitting is liable to occur in service under the normal vibration to which every airplane structure is still subjected.

In making repairs to welded tubular steel structures precautions must be taken to see that the pieces which are to be added for additional strength or replaced to overcome any weakness be properly fitted. In other words, they must not be too long, otherwise buckling caused by expansion strains will occur near the weld. It is fortunate that these can be readily detected.

It is customary when fitting tubes to leave about 1/32" clearance at each end to allow proper fusion and filling up of the weld. It is sometimes possible to straighten a slightly bent tube by means of wooden blocks or a rubber mallet. Tubes which cannot be straightened can be replaced either by butt-welding new tubes to the old structure or fishmouth welding. When the fishmouth type of welding is used the length of the diagonal cuts at the ends of the new tubes should be in ratio of 3 to 1 that of the diameter of the tube. This will result in an area of the welding in shear larger than that of the cross sectional area of the tube itself so that if properly made the weld would be the stronger of the two. It is also customary to use a larger tube than the one sawed off and slip it over the stub ends of the tubing remaining on the structure.

As mentioned before, whenever possible a new weld should never be made on top of another, whether using carbon steel tubing or chrome molybdenum tubing, because there always arises a danger of burning the welds with a resultant structure much weaker than before.

When the butt-welded method is used the inserted tubes should be fitted to the remaining stubs with sufficient clearance to allow for expansion and proper fusion of the welding material. A steel tube sleeve is generally inserted at each end so that it overlaps the weld on either side for a length of about 2 or 3 times its diameter.

Either one of these two types of welding repairs, that is, butt-welding or fishmouth welding, when properly made will result in a structure stronger than the original one. Needless to say, it is absolutely necessary that the alignment be checked before and after welding.

So far we have dealt only with structural welding which must, of course, be carefully done and requires the best of workmanship, as besides good welds uniformity is desired for weight control. For instance—if a difference in weight of one-half ounce per weld is found it may mean a difference of 50 pounds in weight for a fuselage structure which requires 1,500 welds for its assembly and this is quite an item, as after all the airplane must continually fight gravity and every additional pound of useless weight must be carefully avoided.

Besides the applications cited, welding is used in many other places where weight is paramount and the cost of patterns and forgings prohibitive. Many parts are thus made such as levers, brackets, clamps, etc.

The complete line of transport airplanes ranges from the small six passenger cabin monoplane to the largest landplane built on the American continent. Dare we let our imagination wonder what the next few years will develop? Perhaps we can to a certain extent if we compare the phenomenal growth of air transportation for the past few years. Surely, to predict that the time will come when to send a letter by any other way than airmail is not distant cannot be considered crystal gazing.

Figure 10. Construction of Oil Tanks. Every Seam Must Be Tight Against the Slightest Leak, Hence Welded Fabrication.

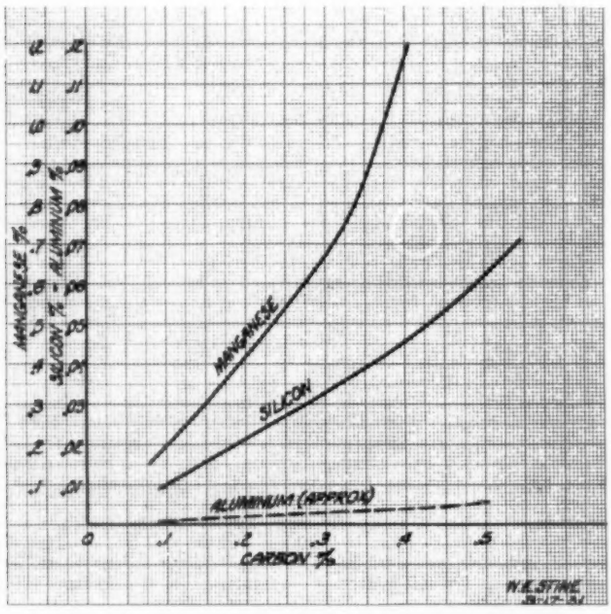
Who can deny that in the near future we shall be able to travel safely and with absolute comfort from New York to Los Angeles or San Francisco from dawn to dusk and sail in giant flying boats powered with Diesel engines from New York, landing in Buenos Aires but a few days afterward.

Speed is most essential today and the old saying—Time is Money—applies more so today than ever.

Let us not forget that the requirements of mankind are ever increasing and they will not be satisfied until modern civilization and its progressive things meet them. Indeed, aviation is, sometimes slowly, but surely constantly recording rapid progress and human achievements. The urge of modern business is demanding more and more of the airplane and welding is playing its part to help it.

Graph Determines Analyses of Good Welding Steel

The variance in the weldability of commercial grades of steel is considered by officials of the Lincoln Electric Company to have been solved as a result of an extensive research conducted by Wilmer E. Stine of their Research Laboratories. The solution is in the form of a graphic formula, known as the Lincoln-Stine equilibrium curve, by which the exact specifications for steels of good weldability are said to be determined. It is claimed that the result of Stine's work



The Lincoln-Stine Equilibrium Curve Which Indicates the Exact Specifications of Good Welding Qualities in Steel.

will prove as great a boon to electric arc welding as ethyl gasoline did to the production of high compression motors.

Heretofore the difficulties encountered in producing sound welds in various grades of steel were often believed to be due to the electrodes and process employed. Wilmer E. Stine thought otherwise, and proceeded to investigate on the basis that the difficulty lay within the steel itself. Due to his intimate knowledge of metals acquired from twelve years' service in the United States Navy as Associate Materials Engineer, Stine realized that research beyond the usual analyses of steels was necessary. Data was collected from the steel producers as to exact conditions and methods under which the steel samples to be tested were made. With this information thousands of samples of steel were welded, tested and analyzed. The results of this research when plotted formed the Lincoln-Stine equilibrium curve.

How to determine the correct proportions of the elements in the steel for best welding becomes a simpler matter with the use of the accompanying graphic formula. For example, if steel having .20% carbon is required, the Lincoln-Stine equilibrium curve shows that the silicon content should be approximately .021%; the manganese .40%. If the steel has been deoxidized in manufacture by the addition of aluminum, the amount of this element present should not be more than .002%. Thus, for any required carbon content of steel, correct proportions of silicon, manganese and aluminum can be specified to insure steel of best welding qualities.

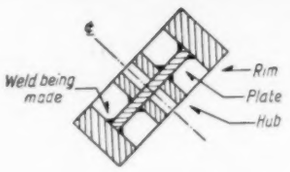
In arc welding steels, produced according to specifications indicated by the Lincoln-Stine equilibrium curve, there is no chemical reaction when the temperature of the metal falls to the point only slightly above the temperature at which the steel solidifies. It is only when such chemical equilibrium is obtained that minimum porosity of weld metal is assured, which in turn means denser, stronger, tougher welds.

In conducting the research Stine also felt that in steels not having the proper proportions of elements for good welding, chemical equilibrium at the proper temperature might be brought about by the use of a corrective flux or autogenizer fused into the steel during the welding process, and during the research developed fluxes or autogenizers for this purpose. Thus, when it is found that the composition of the steel on hand does not meet the requirements indicated by the graphic formula, the steel can many times be satisfactorily welded when such balancing flux or autogenizer is applied.

A Work Handling Tool for Automatic Arc Welding

The young engineer in the accompanying photograph is observing the swift and silent union of two pieces of steel as they pass under an automatic arc welding machine at the East Pittsburgh Works of the Westinghouse Electric & Mfg. Company. Today this type of apparatus produces hundreds of miles of pipe for the petroleum industry, builds up thousands of wheel flanges for street cars and joins tons of steel into tanks of almost every size and description.

An important part of any automatic arc welding operation is the arrangement made for delivering the joints to the correct position for welding. The work handling tool shown in the picture has a considerable effect on the success of the heavy fillet welding required between the web and the rim of a rotor spider. In the fabrication of pieces made up of plate greater than $\frac{5}{16}$-in. in thickness for a full strength fillet, it is advisable to tilt the work in order to obtain the most satisfactory results. The sketch shown in the insert illustrates how this particular weld is made. From this, it can readily be seen that with one vertical and one horizontal



Welding Between Web and Rim of Rotor Spider in the Tilting Tool. Sketch Indicates Welds and How Good Fusion Is Secured.

surface for the fillet, each deposited piece has a tendency to spread out over the horizontal surface, producing a decided overlap together with poor fusion and ragged appearance. The specially designed work handling tool tilts the work so that the two surfaces to be joined are inclined at a 45-degree angle with respect to the vertical, thus forming a trough for the weld metal and permitting maximum welding speed and good metal deposit.

Getting Production on Welded Parts

Increasing the Operator's Productive Capacity During Actual Welding Time Is Accomplished by Protecting Him from Heat, Using Automatic Head and Heavier Electrodes

By Fred Anderson*

MERELY "getting production" is not difficult. But "getting production," as the phrase is currently used, involves not only volume of output but also cost based on some unit of volume. A convenient unit, in the case of welded steel machinery parts, is the cost per ton. While it is obvious that the cost per ton of machinery parts made of an assembly of rolled steel pieces varies, we are perhaps justified in dealing with averages in the hope of getting some perspective of the comparable costs. The economics of the practice govern in the long run since the machinery builder can, in most cases, have his parts made of castings or riveted steel construction. If he uses welded steel construction, it is because powerful economic forces are at work on his business. Briefly, welded steel construction is a good thing if it does not cost too much.

Fred M. Anderson

A recent analysis based on average output indicated that welded steel construction can be produced for $100.00 per ton, including the steel. In this figure, which covers a range of pieces weighing from 130 lbs. to 23,969 lbs., the cost per ton ranged from $60.00 to $300.00. But these wide variations were a small percentage of the total number of jobs analyzed. Before discussing the factors which affect the average cost per ton, it is of interest to compare this with other ways of obtaining machinery parts.

Steel castings of a comparable range would possibly have an average cost of $120.00 per ton. Gray iron castings would cost around $80.00 per ton but on the average twice as much metal would be required due to lower strength and rigidity of gray iron as compared with steel. For purposes of comparison, therefore, we would have to rate gray iron at $160.00 per ton. Riveted steel construction of the complicated nature which would be required for many machinery parts would cost on the order of $200.00 per ton. No comparable average figure can be given covering this type of construction for machinery parts.

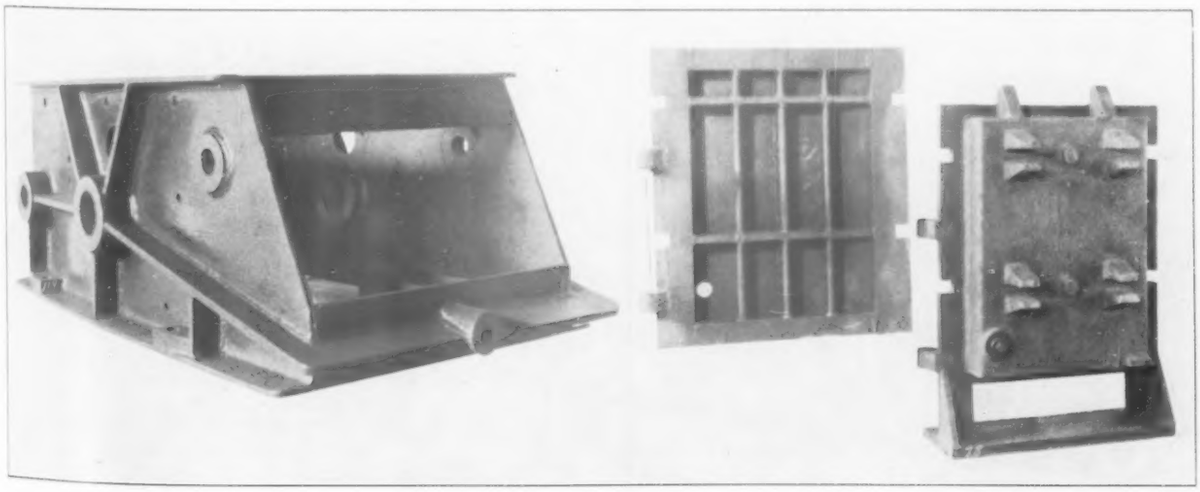
"Getting production" of welded steel parts, therefore, means getting the required volume at $100.00 per ton or less on the average.

The operations starting with cutting, thru the forming in bending brake and rolls to the fit-up and assemble by tack welding, may be handled by well established production methods. The principles are the same for all manufacturing. But when the assembled job reaches the Welding Department a new set of production problems are encountered.

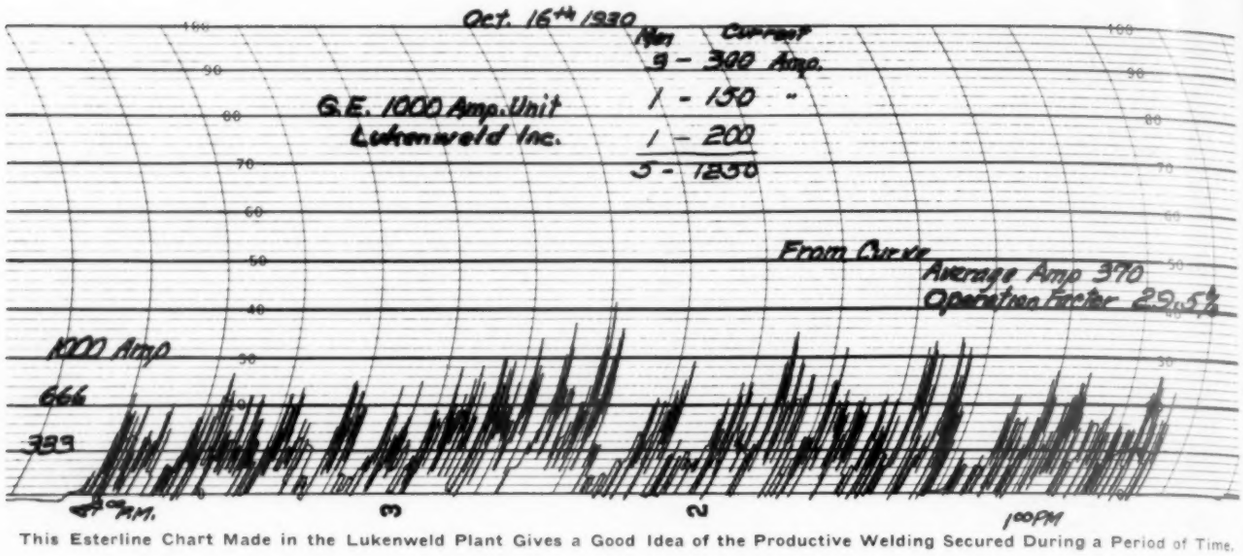
The first problem revolves about the question of how many minutes per hour a welding operator can look at an arc through his shield. The accompanying Esterline chart shows one of hundreds of observations which have been made on manual welding at the Lukenweld plant. The indication is that 45% operation factor is pretty near the upper limit of endurance over any considerable period of time. In other words, the welding operator is productive less than half the time he spends in the shop.

We have discovered, however, that with proper protective glass and clothing the operator can greatly increase the amount of welding he does in a day by increasing the heat

*Superintendent of Welding, Lukenweld, Inc., Coatesville, Pa.



Left: Single Roll Crusher Frame, 24x32 Inches, Weighing 3,000 Pounds. It Is Made of Copper Bearing Steel and of All Welded Construction. Right: Another Lukenweld Product—a Water Cooled Mold Used for Casting Brass. Total Weight Is 1,570 Pounds.



This Esterline Chart Made in the Lukenweld Plant Gives a Good Idea of the Productive Welding Secured During a Period of Time.

and size of welding rod. If the operator will only weld 24 minutes per hour, it is advantageous to have him deposit metal at the highest rate the job will stand during those productive 24 minutes.

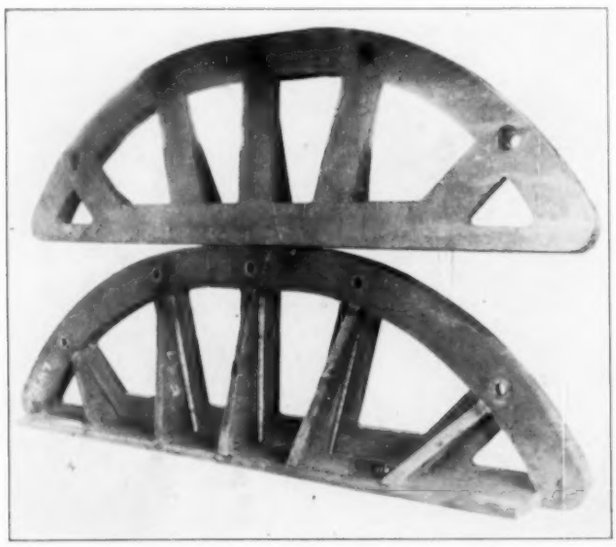
Another way of improving the productivity of the operator is to supply him with the so-called automatic head which holds the arc automatically. With this equipment the operator will not look at the arc any more minutes per hour than in the case of manual welding but he will keep it in operation from 75% to 90% of the elapsed time.

To summarize the problem of getting welding production at suitable costs, it may be reduced to a matter of getting the largest number of pounds of metal on the job per hour. Increasing the heat and the rod size or use of automatic heads are the only two methods known at the present time for accomplishing the result.

The accompanying illustrations of welded parts indicate the importance of putting the metal on at a high depositation rate. Fillet welds on those jobs are in some cases of 1" throat dimension. This means that a pound of metal must be deposited for every 3.5 inches of fillet. The difference between doing it with $\frac{3}{16}$" dia. rod at 2 lbs. per hour and $\frac{3}{8}$" dia. at 8 lbs. per hour is a difference of 4 to 1 in the cost.

The added burden due to increased investment required for 600 ampere equipment in place of 300 ampere equipment is insignificant in comparison with the labor saving. The power cost per pound of metal deposited does not change materially.

Since there is no noticeable tendency in the direction of higher prices for machinery, economies in production are of immediate importance.



These All Welded Steel Base Plates for Open Hearth Ladles (Right and Left Hand) Weigh 3,343 Pounds Each.

Monoplane Wing Frame Is Allegheny Metal Spot Welded

A monoplane with wing construction entirely of Allegheny metal, a chromium-nickel alloy, is undergoing test flights at Roosevelt Field, Long Island. This plane, said to be first to use a wing built entirely of this alloy was built by Fleetwings, Inc.

The wing of the new plane is of full cantilever type, tapered in both plan and section. It has a spread of 41 feet and a chord from front to back of 105 inches at the root and 52½ inches at tip. The weight is 2.14 pounds per square foot, including the ailerons, gear and fabric covering.

The primary advantage of the chrome-nickel alloy for this purpose is the fact that it is not subject to atmospheric corrosion. Thus a new degree of safety is introduced into aeroplane construction. It is the same alloy used on the exterior of the Empire State Building and is also widely used for resisting corrosion in the food and chemical industries.

Carl de Ganahl, president, N. O. Robinson, vice president, and R. C. Berg, chief engineer, of Fleetwings, Inc., have been doing developmental work with this new construction for over a year. Recently they have furnished a full set of ribs of the alloy for sixteen Privateer planes, built by Amphibians, Inc., at Roosevelt Field, and have supplied trailing edges of the alloy to other manufacturers.

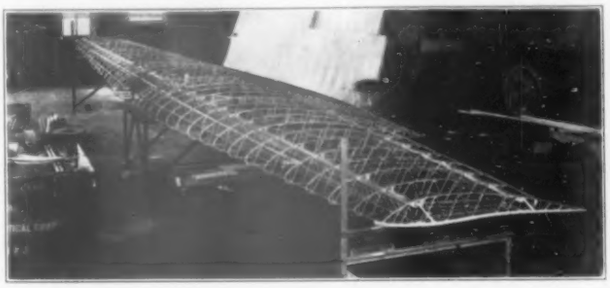
In the new plane, which is the first complete ship turned out by Fleetwings, Inc., the spars, ribs, tail services, trailing edges, control columns and gasoline tank support braces are all of the Allegheny metal. The alloy as used for the ribs is from .008 to .012 inches in thickness; in the spars it tapers from .050 at the center of the wing to .015 inches at the tips. The trailing edges, ailerons and elevator are mostly .012 inches in thickness.

The webs of the spars are made from sheets, .015 to .025 inches in thickness, perforated for greater lightness and all perforations flanged. The cap section of the spar is of cold-rolled strip. The ribs are of cold-rolled strip from .008 to .012 inches in thickness, having a tensile strength of about 190,000 pounds to the square inch. The strip is drawn into tubing, and a modified U-shaped section and the various

members of the wing are spot-welded together. The trailing edges, ailerons and elevator also are made of cold-rolled strip, with a thickness of .012 inches. The entire assembly is spot-welded throughout, the Fleetwing organization having developed a number of special spotwelding machines to meet their requirements. Fittings are made of several pieces of the alloy, some as thick as ⅛ inch welded together.

Besides being non-corroding, the alloy, in the opinion of the Fleetwing engineers, has several very definite advantages for wing construction. One of these is its very high physicals. Although its specific gravity is that of steel, its tensile as used in the Fleetwing ship is about 190,000 pounds. To equal the strength of some earlier metals, weight for weight, the alloy would have to have a tensile strength of about 149,000 pounds, and it is 40,000 pounds above this in the present instance. A second advantage is that the yield point is close to the tensile. A third point argued in its favor by the Fleetwing engineers is that the alloy, which receives its high tensile from cold working, not from heat treatment, can be ordered from the mill with the required physicals.

As compared with chrome steel, which has been used for some spars, the alloy, being non-corrosive, requires no coating of any kind. Steel in similar applications would have to be sand-blasted after fabrication and then coated with red oxide. Sand blasting is difficult in the case of these complicated structural members, and with the oxide dipping, requires two additional operations. The Fleetwing engineers figure that their saving in the matter of heat-treatment corrosion protection, etc., at least makes up for the higher original cost of the alloy.



Fleetwings Wing Frame of Allegheny Metal Spot Welded.

The ribs used passed, with a large margin to spare, a severe test prescribed by the Department of Commerce. In this test rib was loaded to half its design load and the spar points were vibrated at the rate of 1,150 vibrations per minute at 1/32 in. amplitude, for fifty hours, after which the ribs were subjected to a static load test with the full design load. The Department of Commerce requirement was for only 10 hours of such vibration.

Training Welders in the School

By C. D. Moore†

THE progress of welding development has been so rapid in the last few years that it has been impossible to obtain competent men through the ordinary employment channels. It, therefore, became necessary to set up some form of special training to fill the demand for welders.

The Westinghouse Electric and Manufacturing Company, very early in the development of welding, organized a school primarily to train welders for work in the plant. Due to the rapid advancement of welding and the need for design engineers with a practical knowledge of the welding art, the school soon expanded its facilities to serve a three fold purpose: first, the training of operators for manufacturing purposes, second, the training of design engineers for the shop, and third, the training of customer's representatives, both engineers and operators.

In selecting men from our own works for this training, we depend entirely on personal interview and the recommendation of the superintendent of the department in which the man is working. If the man does not prove satisfactory, he is removed from the course and sent back to his department. This, however, has seldom been necessary as we have been fortunate in selecting the right types for training.

Psychological and aptitude tests, no doubt, are valuable in their place, but we believe such characteristics as honesty and conscientiousness, which must be inherent qualities in a welder, can best be found from the man's past history and by close supervision and expert instruction in the Welding School.

From experience it has been found that the man with mechanical training usually develops into the best welding operator. By this training the man has developed the knack of paying close attention to details and a knowledge of the work itself. For instance, when operating a lathe he is working within very close tolerances and must necessarily use fine measuring instruments. In using these instruments his eyes and hands become accustomed to work in close coordination. By his work on the drawing board he has become accustomed to concentrating on a given point. In welding, this coordination of the eyes with the muscles of the arms and hands is of the utmost importance.

The welding trade like any other trade has its specialties, therefore it is necessary that the instructor in the Welding School know the kind or type of work the man taking training will be required to do when he leaves the school. Certain general instructions should, of course, be given to all those in training, but in addition to this, each one should be given special instruction that will fit him to do the particular kind of work he is being trained for.

Before giving instructions of any kind, the students are given a lecture on safety, and are warned especially against the danger of exposing the eyes or skin to the arc rays. They are then instructed in the operation and care of the different types of welding equipment and tools, which they will be required to use during their instruction period in the school and also when they go into the shop as regular welders. Each student is given a hand shield and placed in a booth with one of the advanced students so that he may observe and get a general idea of the procedure to follow.

After about an hours observation, each student will then be assigned to a booth and will be given instructions in the first exercise; this exercise consists of cutting and welding with the carbon arc. The carbon arc is used for this exercise because it is easier to maintain the arc, and the action of the arc flame can be seen more plainly. This gives the student a chance to become accustomed to the handling of the equipment without having to worry about the length of the arc. At this point the students are shown the method of determining whether they have reverse or straight polarity. It is very important that this be thoroughly understood, because many failures of welds have been caused by the operator working with a machine that has had the polarity reversed.

After the student has become fairly proficient in handling

†*Head of Trades Training, Westinghouse Electric and Mfg. Co., East Pittsburgh, Pa.*

of the carbon arc, he is started on the first lesson of metallic arc welding. A great deal of skill is required in order to maintain an even arc and get proper fusion with this type of welding, and since 90% of all arc welding is done by this

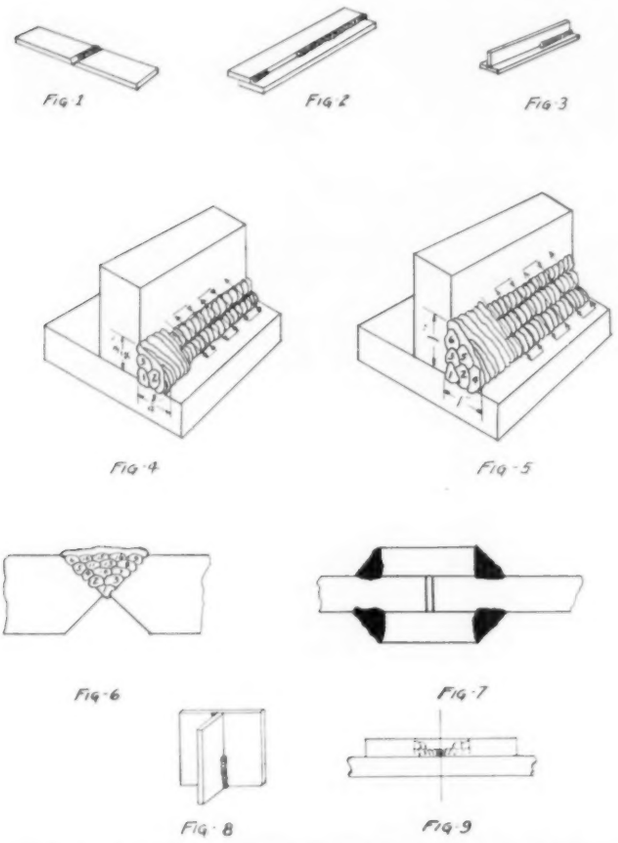


Figure 1. Single "V" Horizontal Butt Weld on 3/8 In. Material. Figure 2. Horizontal Lap Weld on 3/8 In. Material. Figure 3. Horizontal Tee Weld, 3/8 In. Fillet. Figure 4. Horizontal Tee Weld, 3/4 In. Fillet. Figure 5. Horizontal Tee Weld, 1 In. Fillet. Figure 6. Horizontal Butt Weld. Figure 7. Double Strap Butt Weld (Final Test Piece). Figure 8. Vertical Tee Weld. Figure 9. Plug Weld.

method, it is very important that the student practice each lesson until very good results are secured. The beginner starts by laying beads on a plate in a horizontal position. The necessity of maintaining the proper current regulations and the correct length of arc is stressed very strongly. Maintaining the proper arc proves very difficult at first, but becomes easier with practice. These exercises should be practiced with the travel in all four directions using both the straight line and weaving manipulations.

In the next lesson the student is required to lay beads on a plate inclined at an angle of 45°. It is necessary in this exercise that a very short and steady arc be maintained in order to get penetration and prevent the metal from rolling down the plate. Considerable practice is required in this exercise. From this point all the students perform welds that are designed so that they may be broken or etched with acid so that the student may see the actual results of his weld. Only in this way can they hope to learn the things to avoid and know the general appearance of a good weld. The most important exercises are the Horizontal and Vertical Butt Welds, Horizontal and Vertical Tee Welds, and Plug Welding. All students are instructed in the proper procedure and the metals to be used in the welding of cast iron, copper, and chrome nickel alloys. Each student is required to take a final test which includes ½", ¾", and 1" Horizontal Tee Welds, also ½" and ¾" Vertical Tee Welds. The final test piece is a Double Strap Butt Weld; this test piece must stand a pull of not less than 40,000 lbs. per square inch. The Tee Welds must have not less than 90% fusion (Fig. 7 shows Double Strap Butt Weld). This same type of test is used for welders in the shop.

This entire course covers approximately 300 hours. The man, of course, is not considered an expert welder upon the completion of this course. There is much to learn yet that can only be gotten through actual welding experience on the job. Men who are trained for welding in our own shop are followed very closely for two months at least, after they leave the school and are employed on welding work. The foreman of the Welding School is responsible for the shop training as well as the training in the school. It is his duty to see that these men are given special training on whatever line of work they are employed. Each man who passes the test satisfactorily is given a certificate stating that he has completed a course in Arc Welding. This qualifies him to receive a stencil, which our shop welders must have. Each welder stencils his own work so that it may be identified if defective work is discovered. Each man in welding work in our shop is required to make a test piece once each month. Those failing to pass the test are taken off welding work and when necessary returned to the school for additional training.

New Tests Show Dependability of Flame-Cut Connections

An interesting series of experiments has recently been conducted by the American Bridge Company for the purpose of determining the dependability of structural details for wind connections when fabricated with the cutting torch. Some experiments which have been made in the past have yielded results which caused a certain amount of difference of opinion regarding the advisability of using the cutting torch for this purpose. The samples recently tested by the American Bridge Company were duplicates of wind connections used in the Empire State Building, New York City, with the exception that the ends were extended somewhat to make the testing more convenient. The samples were tested by impact-bend tests at the shops of the American Bridge Company at Ambridge, Penn., and tension tests and static-bend tests were made at the Bureau of Standards, Washington, D. C. The tests did not cause any fractures to start at the flame-cut edges or at the edges which had been flame-cut and subsequently planed. The results as a whole were such as to indicate that the quality of flame-cut connections is perfectly satisfactory with no sign of brittleness having developed.

Nickel-Clad Tank Car Is Welded

In a recent issue of Chemical & Metallurgical Engineering is a description of a nickel-clad tank car built by the General American Tank Car Corporation in cooperation with the Lukens Steel Company. The purpose of this type of tank car was to provide a method of transporting caustic soda. Two such cars are now in service and several others are under construction. The cars are so designed that the caustic soda comes in contact with only pure nickel. In fabrication of the sheets for the tank, slabs of steel and nickel with carefully prepared surfaces are placed in intimate contact. The two are heated in the proper atmosphere and to the proper temperature, and rolled to the finished plate. In the fabrication of the tanks there is a good deal of riveting, and rivets of pure nickel are used. Heater coils are made of seamless 2 inch nickel tubing. In some parts of the car welded seams are used. It has been found that these nickel-clad steel plates can be butt welded with perfectly satisfactory results. Metallic arc welding with a heavily coated nickel rod is the process used. In the fabrication of the heater coils the nickel tubing is welded with nickel welding rods.

The A.W.S. Structural Welding Code*

A Review of the Conditions Leading up to the Completion of the 1930 Code. and What this Promises for the Welding Industry

By H. H. Moss†

STANDARDIZATION of practices in manufacture and construction, which designers and workers in these fields of industry employ is the milestone which marks the transition from what may be termed individualistic production to that of mass production. This applies, generally speaking, to the specializing fields of manufacture or construction as well as to those fields which have been more or less generally invaded.

It is an American axiom, particularly in the basic industries, that mass consumption is the reward of standardization. By this means, uniformity in quality and resultant usefulness is assured and by the same process the maximum economy is obtained.

As each new art, economically useful in the industrial scheme of things, is brought to the point where its production practices have reached the stage where they may be properly standardized, so may we log the progress in the development of that art to the point of common usefulness.

In the welding field, which has, in a little more than a decade, invaded practically every known field of industrial activity, we are constantly confronted with the work of standardizing proven applications so that mass utilization can proceed. In detail it amounts to passing the design standards and welding technique on to regulating bodies, executives, engineers and the welding craft generally.

One of these which has recently received the joint consideration of the welding industry is the art of welding as applied to the fabrication of steel frames for buildings.

The Demand for Specifications

It was not long after the early stages of development in this field dating back about six years, which bore good evidence to those who witnessed the results that fusion welding was a practical tool for the joining of steel building parts, that demands were made upon the welding industry for specifications or rules whereby others might employ this tool.

Specifications setting forth the rudiments of the art prevailing in different schools of thought at that time, were submitted in answer to these requests. Upon these data quite a few structures were erected by welding.

Along with this action, further development work was going on at the hands of special interests sponsoring structural welding until nearly 10,000 tons of structural steel had been so erected.

In going back to review the practices of that time, one will find considerable disagreement as to the detail prescription on design and welding technique compared with the practices commonly recognized at this time.

Early Design Data

Unit working stresses for fillet welds varied from 7,500 to 11,000 lbs. per square inch. For butt welds, from almost entire prohibition to 13,000 lbs. per square inch. The design criteria for joint preparation and for the position of joints or welds encountered in structural assemblies was quite vague. Applied design was as varied as was design of reinforced concrete during its early stages of development. The recommended welding technique varied considerably and the language of welding was inconsistent, making it difficult for the layman to understand different commentators.

Nevertheless the art progressed and the singular feature of it all was that no failures occurred. The structure stood up under the loads imposed. True, the costs were not always favorable compared with the costs of the methods of construction which were replaced, but there was good indication that due economies would be realized in time.

Building Codes Appear as an Obstacle

In the second stages of the development of structural welding which marked the appearance of welded building structures inside the jurisdictional provinces of municipal building laws, the first real obstacle to its further progress on a broad commercial scale was encountered. The laws in the cities wherein these structures were permitted to be built (the permits being obtained through special permissions granted by Departments of Buildings upon evidence of unusual ability on the part of those understanding the work) did not provide for this modern tool of construction.

The regulatory personnel of the Building Departments had little, if any, knowledge of welding and it was only natural that strong resistance was placed against the employment of this method of construction at the hands of the construction industry practicing within these cities.

Concurrent with these developments, a considerable amount of dispute was going on in connection with the merits of gas cutting in the shaping of steel parts for buildings. A measure of the protests causing these disputes was, no doubt, justified as it was observed that the practices of gas cutting in this field were not in all cases in agreement with the practices for this tool as recommended by our industry. There was an evident lack of proper understanding of the purpose of this tool.

The confidence, essential to any method of construction if it is to enjoy wide usage, was lacking and uniformity in these several applications was not in sight.

A. W. S. Appoints Code Committee

In answer to this situation the American Welding Society took a definite step to bring the responsible interests together in order that there could be effected a meeting of minds as to the factors in structural welding and gas cutting essential to sound design and application. The Society appointed a Committee on Building Codes whose first work was to render whatever assistance it could logically give in matters of inquiry or dispute in connection with these applications and to draft regulations for fusion welding and gas cutting in structural steel for buildings upon the practices which had reached a stage where they could be properly standardized.

Upon investigation the Committee found considerable material upon which to build and it promptly started to fulfill these assignments and by the close of 1928 had completed a draft of a Structural Welding Code, which the Society published early in 1929. This code was entitled "Code 1, Part A, Code for Fusion Welding and Gas Cutting in Building Construction, Edition of 1928."

5,000 Copies of 1928 Code Distributed

Copies were distributed throughout the United States and Canada, one copy being submitted to all Building Departments on record at that time in this country. Five thousand copies of this edition were printed but within a few months

*Read before the 31st Annual Convention, International Acetylene Association, Chicago, Ill., Nov. 12, 13, 14, 1930.

†Engineer, The Linde Air Products Co., New York.

after it was made available the first edition was exhausted. A second edition was obvious but while considering this step it was recognized that the reference matter, consisting of two publications of the American Bureau of Welding, would have to be likewise reprinted. In short, the Committee decided to republish the Code so that reference to the Bureau publications would not be necessary in order to obtain a complete interpretation. The Edition of 1930 resulted, which was made available in October of this year, and which is now being distributed throughout the United States and Canada.

The 1930 Code Appears

The 1930 Edition, quoting from its Preface, includes an appendix which is primarily a digest of the publications referred to in the 1928 Edition, with the explanatory matter where needed to make it more applicable to code purposes. A few minor changes were made in the body of the code, which are explained in the 1930 Preface.

The code therefore, in its present form, not only provides proper specifications for applied structural welding and gas cutting, as agreed upon by the welding industry at large, but also contains sufficient practical data on arc and gas welding to enable construction executives to differentiate between acceptable and non-acceptable workmanship.

The Results

The results of this work of standardization are beginning to be felt. To date nearly 100 cities and towns have adopted, either in whole or in part, the recommendations given in the body of Code 1, Part A, among which are the cities of Sacramento, South San Francisco, Berkeley, and Pasadena, Calif.; Shreveport and Monroe, La.; Helena, Mont.; Olympia, Wash.; Albuquerque, New Mex.; Utica and Syracuse, N. Y.; Lynn, Mass.; Wilmington, Del.; Dallas, Texas, and New Orleans, La. This means that structural welding by arc and gas methods and gas cutting of structural steel along the lines recommended in the Code are permitted to be used in these towns and cities under the regular procedures of construction.

Many cities now working on revision of their Building Codes are considering a similar action, among which are some of our largest municipalities.

The Code is being recognized as a standard by organizations which are promoting better construction and it has been observed that current applied design is in good agreement with the recommendations set forth in Code 1, Part A.

The Outlook

The process of standardization is in operation. Structural welding practices are being levelled out throughout this country and the characteristics of development in this field at the present time are more along the lines of economic design than in details concerned with unit stress, weld technique, and the like.

The accrued welded tonnage in buildings and bridges at this time, should all data be assembled, would approximate 100,000 tons, involving structures of the simple one-story type to the twenty-story building. In bridge work, structural welding will be encountered in both highway and railway structures, and the number of jobs in contemplation at this time offer a very promising outlook.

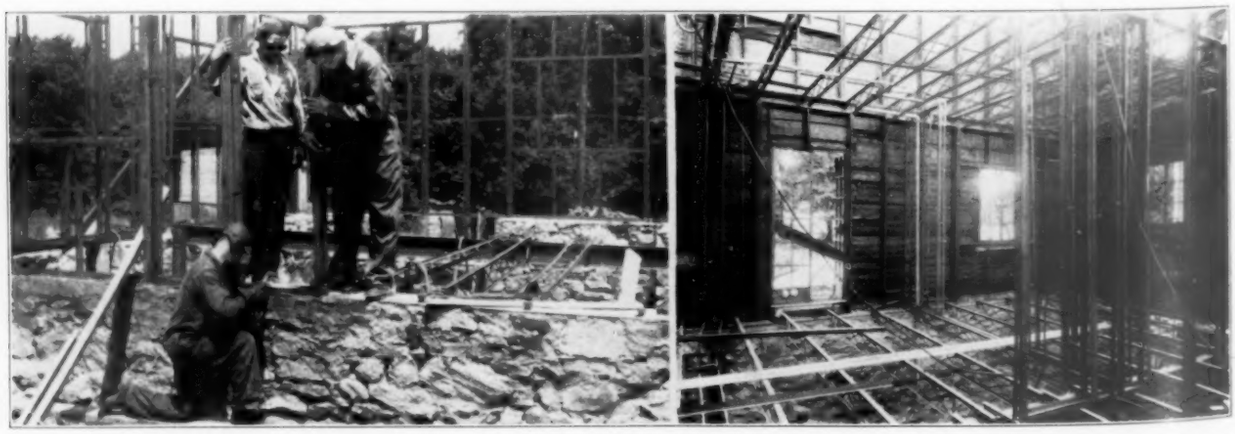
The following is the personnel of the Committee on Building Codes as constituted at this time:

F. T. Llewellyn, Chairman, U. S. Steel Corporation.
J. L. Anderson, Air Reduction Sales Company.
H. G. Balcom, Consulting Engineer.
C. T. Bissell, National Board of Fire Underwriters.
Frank Burton, Steel Joist Institute.
E. A. Doyle, The Linde Air Products Co.
Gilbert D. Fish, Westinghouse Electric & Mfg. Co.
Grover A. Hughes, Truscon Steel Company.
J. C. Lincoln, Lincoln Electric Company.
F. P. McKibben, General Electric Company.
H. H. Moss, The Linde Air Products Co.
James W. Owens, Welding Engineering & Research Corp.
Edmund Von Steeg, General Electric Company.
C. C. Whittier, R. W. Hunt Company.
Herbert A. Woofter, Swift Electric Welder Co.

A Welded Dwelling House

WHAT is thought to be the first all welded brick and steel dwelling constructed by electric arc welding was recently built for and is now being occupied by C. E. Anthony of Larchmont Gardens, New York. It is a six-room, two-story building, 32 feet by 26 feet, with full basement and a two-car basement garage, and is built on a foundation of stone and concrete.

The entire framework and all interior partitions were made up of standard size panel frames previously fabricated in the welding shop from 1½-inch angles. They were made up of two duplicate frames tied together with spacers to provide the regular wall thickness of four inches throughout the house. Two sizes were used, the wall sections in which there are no windows being 2 feet by 9 feet. The window sections are 6 feet by 9 feet, of sufficient size to accommodate any window normally used in a dwelling house.

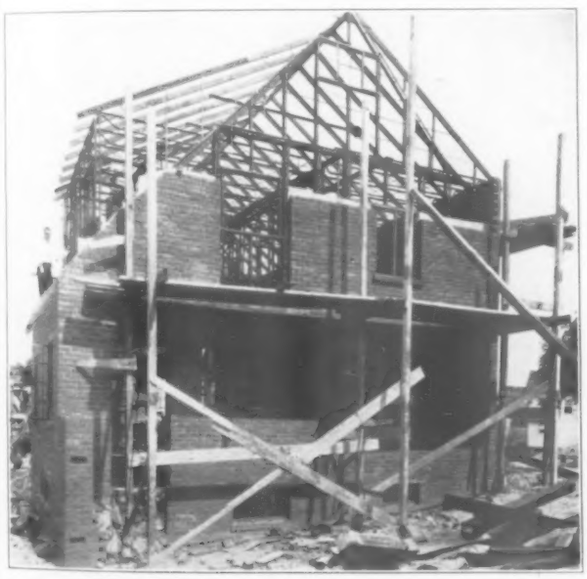


Left: Welder Making the Welded Connection Between the Foundation and Framework. Right: Interior View Showing Metal Framework and Lining of Walls.

In erecting the walls and partitions, a plate sill 6 inches wide by ¼ inch thick was laid directly on the foundation to take care of any roughness on the concrete, and fastened down by means of bolts grouted in the concrete. The fabricated panels were then welded to the sill. Adjoining panels were welded together at their edges to make a solid structure throughout. The second floor was erected in exactly the same manner and was welded to the top of the first floor sections. Electric current for all field welding was generated by a General Electric gasoline engine-driven arc welding set.

An 8-inch I-beam was used for the main floor bearing beam. All floor joists, on both the first and second floors, are of steel truss construction, 8 inches deep, and welded to the frame of the house at each end and to the bearing beam or partitions in the middle. This type of floor beam was used because it provides rigidity without excess material. Steeltex, a 2-inch wire mesh spot welded at each juncture and interwoven into fire-resisting, waterproof paper, is laid directly over the floor joists and covered with a 2-inch course of concrete to make up the floor.

The roof supports or rafters are 4-inch channels with 2-foot spacing and are welded directly into the outside wall framework of the building. The gable sections were fabricated in the shop, trucked to the building site, hoisted into place and welded to the framework proper. The roof covering consists of Steeltex placed directly over the rafters and covered with a 2-inch layer of Nailcret, a concrete asbestos composition of such characteristics that nails can be driven



The Metal Framework Is All in Place and Part of the Outer Brickwork Completed.

into it for laying shingles. A layer of slate shingles was used.

The outside of the house is finished off with a brick veneer inside which is placed a layer of Steeltex, to the top of the second floor level. The gables and dormer are finished with stucco. All windows are of the steel casement type welded into the framework of the building. All doors are of Kalman steel construction, set in steel bucks and frames welded into place.

The interior finish of the house consists of Steeltex over the framework, and hard plaster. In fastening the Steeltex in place, attachment bars consisting of small rolled steel channel with wire fasteners spot welded to it were used. The channels are securely tack welded to the steel framework and the Steeltex tied in place by means of the wires.

The floors are covered with Armstrong inlaid linoleum with a felt backing on both the first and second floors. The stairways are steel with ornamental iron railings, welded in place, and have Sutterlith treads—a composition of plaster of paris, cement and sawdust. All baseboards are also made of this material.

The interior and exterior appearance of the house are no different from that of any other similar house. The lower floor is laid out with a living room, dining room, kitchen and vestibule. The second floor has three bedrooms, a bathroom

General View of the All Welded Dwelling After Completion.

and ample closet space. In the basement, welded construction was also used in the installation of a welded oil burning furnace and a welded hot water heater.

Many advantages are claimed for the welded type of construction, among them being the following: rapidity and noiselessness of construction; use of standard panels; flexibility of design; fireproof construction, giving lower insurance rate; rigidity and solidity, eliminating vibration, low rate of depreciation and soundproof walls.

How Locomotive Cylinders Are Decarbonized

The process of removing carbon deposits from the cylinders and piston heads of internal combustion motors by the use of oxygen is almost as old as gas welding. A technical bulletin recently issued by the Gas Products Association, 250 East Ontario street, Chicago, points out that this same method is being used with equal success in the maintenance of steam locomotives. The reason given for carbon deposits in locomotive cylinders and the necessity for its removal is that with the present day high-pressure boilers and particularly where steam superheaters are employed, the operating temperatures are sufficient to crack the lubricating oil into light vapors which pass off with the exhaust steam, a heavy carbon residue collects in the cylinder and piston heads in the steam supply port and around the valve chamber bridges, causing loss of power due to restricted passages. The deposits are said to be not restricted to any particular type of locomotive, but are more in evidence on engines equipped with superheaters. The carbon collection in the steam supply port and valve chamber are not readily accessible for removal by scraping or chipping with chisel. Owing to this inaccessibility, the process of hand chipping results in a rather high labor charge which can be reduced greatly by the use of the oxygen burning process. A report of this kind of work which was done in England stated that the average consumption under foreign conditions amounted to 300 cu. ft. of oxygen per cylinder decarbonized. One indication of the possible volume required for this purpose is indicated by the fact that one railroad system decarbonized an average of 150 locomotives per year by use of oxygen.

Some Resistance Welding Problems*

Spot Welding Precious Metals to Spring Stock—Butt Welds in Permalloy Wire—Butt Welding Copper Rod and Wire

By C. L. Pfeiffer†

In Two Parts—Part Two

AN important welding operation in the manufacture of communication apparatus is the welding of precious metal contacts to various relay and key springs. This method of assembly has replaced the old type platinum contact rivet and has saved a large percentage of contact metal formerly required in the rivet shank. In addition, the use of a point contact on one of a pair of springs and a disc on the other

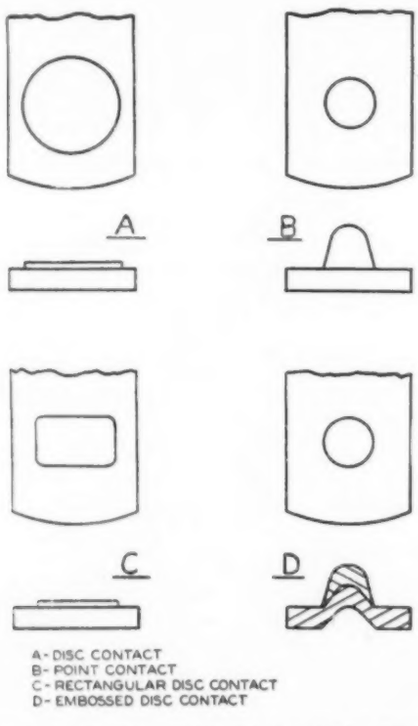


Figure 6. Precious Metal Point and Disc Contact.

has simplified accuracy maintenance in both welding and assembly.

There are two types of semi-automatic machines in use at the Hawthorne Plant of the Western Electric Company for welding contacts of the type shown in Fig. 6. The point machine feeds the end of a precious metal wire through an electrode into contact with a nickel silver spring. At this point the welding current is applied to fuse the wire end to the spring. Immediately thereafter a cutter snips off the proper length of precious metal, following which a die forms the welded wire into the desired shape. On the disc machine precious metal tape is fed into a miniature punch and die and the proper sizes of contact discs are punched out. Fingers engage these discs and place them in the welding position between the welding electrodes. A forming hammer is also used on this machine to insure a smooth surface on the welded disc.

Efforts are being made constantly to save the costly contact metal. Methods for replacing parts of the precious metal not used during the life of a piece of apparatus are always under consideration. Recently a method of embossing certain point contacts has gone into production. Fig. 6-"D" illustrates the contact produced by this method. The cycle of operation in making these contacts is the same as on the point welding machine. The cutters snip off less contact metal, but the embossing tool used in the forming operation raises the contact metal cap to the required height.

A study of point and disc contact alignment revealed that a rectangular contact could be substituted for this disc design. Sketch "C" in Fig. 6 compares the shape and size of this contact with the former type, shown in Sketch "A," Fig. 6. The new design is more difficult to weld because greater skill is required in dressing electrodes, but the saving in contact metal is substantial.

A recent investigation of precious metal shortages on point contacts revealed the extreme importance of the shape of clipped ends. A soft contact metal point was being replaced with harder metal of the same shape. The wedge shaped cut used on the softer wire gave the welded cross-sectional area shown in "A," Fig. 7, and the harder wire gave a welded cross-section shown in "B." These differences could only be detected by microscopic examination. The wedge point of the harder wire was not flattened sufficiently when pressure was applied before welding, which reduced the contact area. Since the harder material also had a higher melting point, the wedge shape was retained during the welding cycle and the subsequent forming operation tended to drive the contact metal shape into the nickel silver spring. This

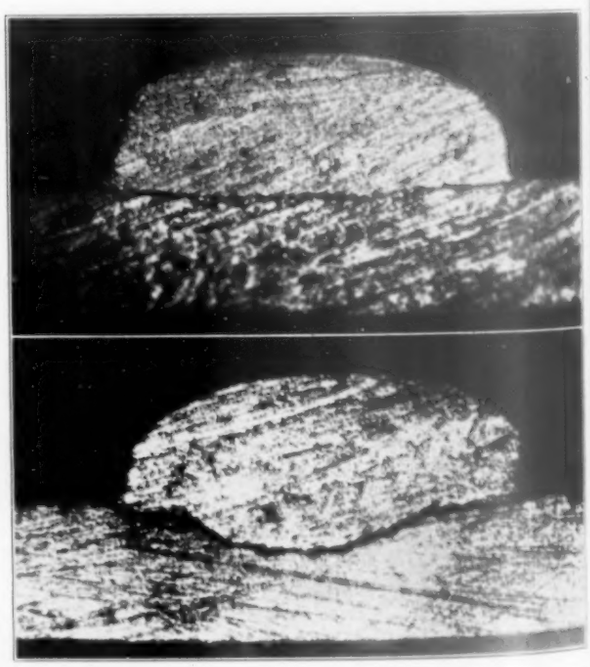


Figure 7. "A" Above, a Weld Made with Soft Contact Metal Wire. "B" Below, Is Welded with Hard Contact Metal Wire.

*Abstract of a Paper read at the Annual Meeting, A. W. S., New York City, April 22-24, 1931

†Engineer in Charge of Welding Development, Western Electric Co., Hawthorne Plant.

condition was remedied by flattening the cut end of the wire so that each side of the wedge angle was reduced by 25 deg. The reduction in cutting angle made possible welded sections comparable to the softer metal shape.

A bench type punch press welder is used for welding multiple brush springs. Each spring consists of a piece of .015-in. nickel silver about ¼ in. wide, to which is welded a .025-in. brush shoe about .075 in. wide by ⅜ in. in length.

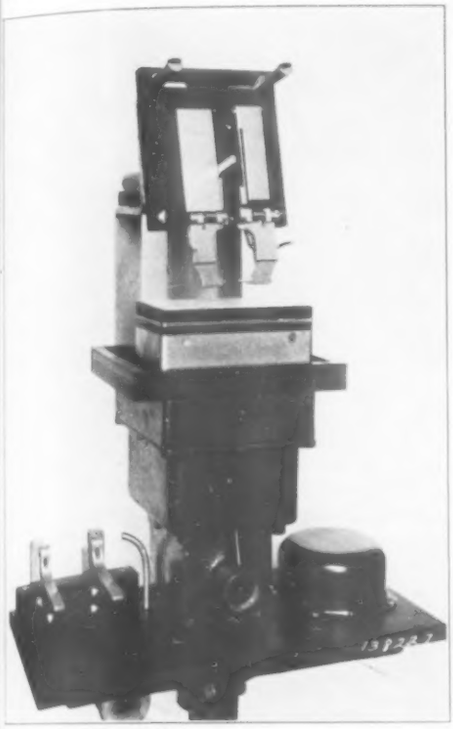


Figure 8. A Butt - Welder Used in Joining .011 - Inch Permalloy Wire Under Carbon Tetrachloride.

Two welded joints are made at the same time at either end of the shoe, one a hybrid joint and the other a projection weld. The shoe is shaped like a zee-bar section which fits an offset portion of the nickel silver spring. The parts are placed in a special hinged welding fixture. A duplex joint is fundamentally difficult to make, and the problem was complicated by the addition of a fiber bushing between the bronze shoe and nickel silver spring. The fixture is placed between the copper electrode of the press and a foot pedal motion completes the subsequent welding operation.

Fig. 8 shows a butt-welder used in joining .011-in. permalloy wire under carbon tetrachloride. The jaw mechanism is made of monel and is of very light construction. The right jaw is movable and actuated by a vertical blade spring. Fig. 9 shows the wiring diagram of this welder. The secondary circuit has a resistance ballast in series with the welding jaws which serves both as a timer and a current tapering device. This resistance ballast is made up of a variable resistance of about 1.6 ohms and a .008-in.-2-in. nickel fuse connected in multiple. The wire ends are clamped in the welding jaws, spaced at .066 in., immersed in carbon tetrachloride and a current of about 100 amperes is sent through the circuit. In an instant the wire ends become plastic, the nickel fuse blows, the current is reduced and the jaws move together to a distance of .033 in. As long as the welding key is depressed the reduced current flows through the joint. Approximately 3 in. of wire on either side of the weld is next annealed in the annealing terminals shown at the top of the wiring diagram, Fig. 9. The resulting joints are very strong and can be drawn through wire reducing dies. Fig. 10 shows the great difference in appearance of .011-in. wires welded in air and welded under carbon tetrachloride. The air welds are brittle, have a crumbling flash and can be broken easily. The carbon tetrachloride welds are smooth and tough, and

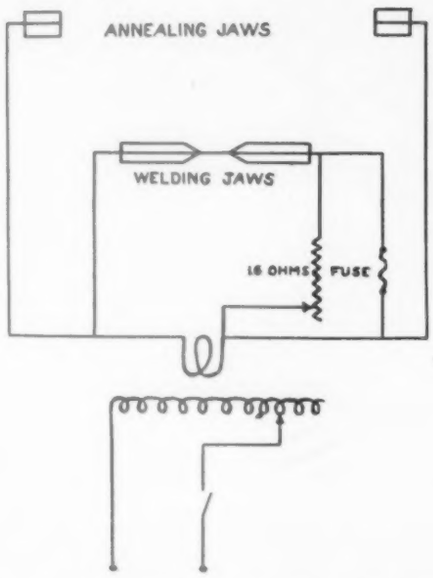


Figure 9. Wiring Diagram of Permalloy Butt-Welder.

as strong as any part of the wire. Small nichrome, chromel, perminvar and iron and constantin thermocouple wires can easily be joined by this method.

In welding copper rod a butt welder is used. High current densities, ranging in value from .2 to .4 amperes per circular mil and applied for very short intervals are used for making joints suitable for drawing. For stabilizing the welding current a resistance or reactance ballast is used in the secondary circuit. Rod ends are cut square by means of a circular saw operated by the foot pedal at the left of the machine. This insures good contact and practically eliminates so-called contact resistance and its attending variations. The moving jaw is delicately balanced and is mounted to respond instantly when released. The pressures are selected to insure the proper coordination of jaw movement and current cut-off. Clamps are used to hold the welded joints in a vertical position so that the welding flash may be easily removed. Aluminum for drawing purposes may be joined on similar equipment. However, for this work current densities must be adjusted to about .1 to .25 amperes per circular mil and the jaw pressures tapered off so that the pressure on the joint immediately previous to solidifying is practically zero.

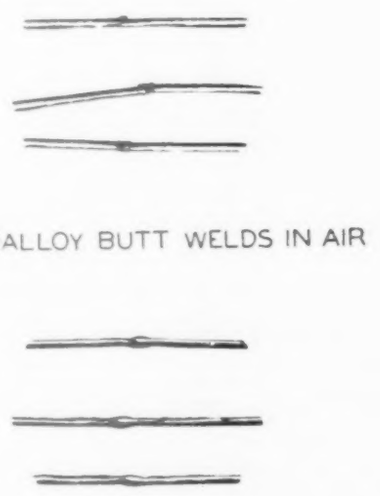


Figure 10. .011-Inch Permalloy Butt Welds.

Copper rod and wire welds may also be made under various liquids. Although joints made in water and a solution of hypophosphorus acid have a much cleaner appearance, no increase in strength over those made in air can be detected.

Welders may be used in the manufacture of iron and steel wire, in galvanizing processes and for joining wires and tape used in cable armoring. Iron and low carbon steel wires may be butt-welded, trimmed, redrawn or galvanized and used as part of the finished product. It is very difficult to produce high carbon steel welds which may be substituted for the stock being joined. The completed joint must be carefully heat treated in order to develop characteristics even approaching the original stock.

A punch press type welder is used for welding magnetic iron pole pieces of a telephone receiver to the carbon manganese steel magnet. Fig. 11 shows a close-up of the fixture and parts being welded. The levers shown on the fixture clamp the parts to the electrodes, the tips of the pole pieces projecting through slits in a brass cup. At the completion

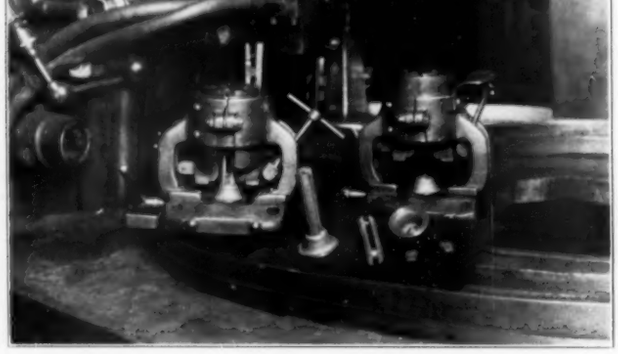


Figure 11. Close-Up of Punch Press Type Welder for Joining Magnetic Iron Poles Pieces to Carbon Manganese Steel Magnet.

of the welding cycle the cup is securely fastened so that it acts as a support for the entire magnetic structure of the receiver.

This paper presents some of the resistance welding problems found in a highly specialized industry. The conclusions are all based on work performed at the Hawthorne Plant of the Western Electric Company. It is believed, however, that conditions at this plant are not unusual, but typical and representative of such work anywhere. It is hoped that this discussion may aid in the solution of general resistance welding problems.

Interesting Repair Jobs From The California Oil Fields

By W. E. Archer

ROTARY TABLE TEETH AND PINIONS BUILT UP WITH THE ARC

New ways of applying the use of welding are constantly being developed in the oil industry. The accompanying photographs illustrate another way that welding is affecting a great saving in production costs in that industry. This work is building up teeth on both the rotary table and the drive pinion which drives and rotates the drill stem, or "Kelly," as it is termed in drilling-crew vernacular.

Closeup views of the dismantled rotary table shown here were taken in the welding shop of the Shell Oil Corporation at Signal Hill, California. This equipment is subjected to great wear and strains, especially when drilling is being done at great depth, in hard formation, or in case of crooked-hole difficulties, etc. Frequent changes in pinions or rotary tables —and often both—are necessary owing to these conditions. Before this building-up process was developed and adopted, this installation of new equipment meant considerable delay and expense to drilling contractors and production departments. The installation of a new rotary table (the section alone which carries the teeth) meant an expense item of about $450.00, while a new pinion costs in the neighborhood of $140.00, making a total outlay of about $600.00 for both.

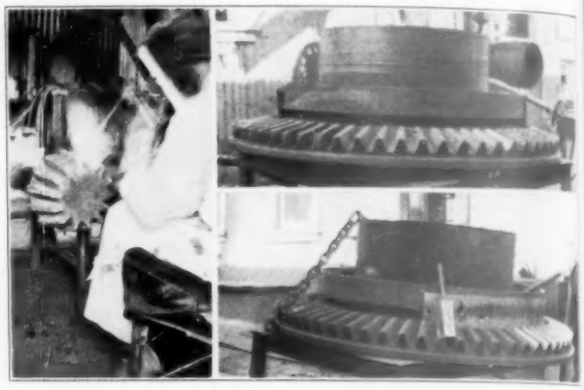


Figure 1. (Left) Welder at Work on One of the Pinions. Figure 2. (Above) Rotary Table After Welding. Very Little Grinding is Necessary. Figure 3 (Below) Almost Ready to Go Back to Work.

By the use of welding, both the pinion and the rotary table can be built up and ground ready for use at a cost of about $60.00, or about ten per cent of the cost of new equipment. And, furthermore, the built-up teeth wear a great deal longer and give much better all-around service than the new equipment direct from the manufacturer.

This work is done entirely by the electric arc process, an operator being seen in Figure 1 at work on one of the pinions.

Figure 2 is a view of a rotary table just after the building up process was completed, and before any grinding was done, a very nice piece of work, as can be seen.

Figure 3 shows a table with the teeth built up and about half of which are ground to proper size and shape. Note gauge used for this purpose resting between two of the teeth in the picture. Stoody H. C. rod is being used in this procedure.

* * *

BROKEN CORNER OFF LARGE ENGINE FRAME REPAIRED BY ARC WELDING

Figure 4 is a close-up view of a heavy repair job in welding by the electric arc. The photo clearly shows the weld at the break on the corner of a Clark Engine frame located in a gasoline plant at Signal Hill, Calif.

Figure 4. Close-Up of a Heavy Repair in an Engine Frame Made with the Arc.

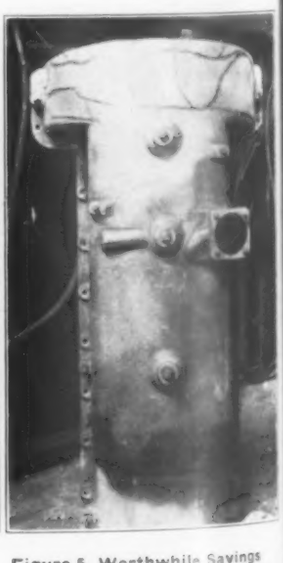


Figure 5. Worthwhile Savings are Made by Welding Broken Aluminum Crank Cases.

Welding procedure of this repair job was by beveling and studding. After the beveling was completed, 5/8-in. studs were inserted, staggered on each side of the break. The welding was then started by running small beads around the studs and covering the entire surface of the base, after which gradual building up was completed. As small rods as possible were used, with very small amperage. The thickness of the frame at the place of the repair was about two inches. About two days time for the welder and one helper was required to finish the job.

This job was done in the Texas Oil Company's Refinery Plant No. 2, situated in the Signal Hill oil field. The work was done by J. W. Shipp, one of the company welders. A great saving was realized in the successful completion of this job, as one can readily realize by the fact that it eliminated the expenditure of several hundred dollars for a new engine frame. The entire cost of the repair job was in the neighborhood of $45.00.

* * *

OXY-ACETYLENE WELDED ALUMINUM CRANK CASES

Marked savings are being realized by the Mack Truck Company in Los Angeles, Calif., in the repairing of their aluminum truck motor crank cases by welding.

Figure 5 is one of these crank cases which is from one of the A-B Model Mack trucks. This truck was in a wreck and the lower crank case was badly broken as is shown by the black chalked lines at the top end. This entire bell end was practically torn away and broken in many pieces. The process used in repairing these crank cases is by oxy-acetylene. Procedure of building up was by bulking up the under side with sheet iron and filling in the missing sections. Ordinary aluminum rods, poured from old melted aluminum crank cases, were used.

This job was finished in approximately four hours time for the welder. Mr. Foy who did the job states that experience has taught him that sheet iron is the best metal to use for a backing plate on jobs of this nature, due to the fact that any other metal has a tendency to adhere and take off the surface, thus making a rougher job.

The saving in this repair job over a new crank case, is about $110.00, a new case costing about $125.00 while the repairing of the old case did not exceed $15.00.

Welded Steam Coil For Heating Crude Oil

The Shell Oil Corporation recently completed a nice job of oxy-acetylene welding in the company's welding shop at Signal Hill, California.

The job, which not only saved the company considerable money in the welded construction of the item itself, but its use will also mean a great saving in its operation. The piece of equipment is a steam heating coil made of 2-inch pipe for installation in crude oil storage tanks, the purpose of which is to heat the heavy crude oil as it comes from the well in order that it may be more easily and rapidly transported through

Figure 1. All Bends Were Made by Heating with the Torch.

the pipe lines. The coil is used in connection with a low pressure boiler, to be operated automatically by thermostat control with a closed steam system. The automatic feature, eliminating the necessity of a fireman being on duty, is in itself a great saving.

This heating coil which is made of 2-inch pipe, is all-acetylene welded. Bending to shape required as seen in the accompanying photograph (Figure 1), was done by acetylene torch heat. The inside or start of the cone-shaped coil was done by welding the end of the first joint of pipe to an old

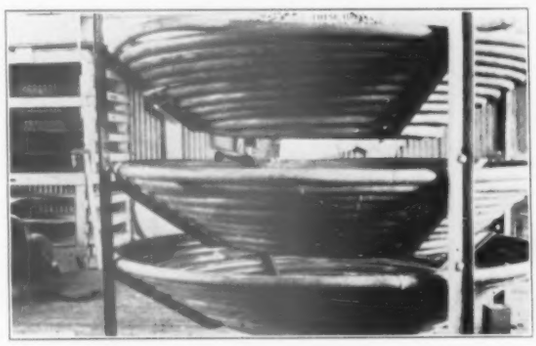


Figure 2. After All Welds Were Made, the Coil Was Telescoped to Proper Shape.

pulley, four feet in diameter, for a core. The pipe was thus heated and bent by wrapping around continuously, one wrap on top of another, each joint of pipe being welded on as the coil was being wrapped. After the required amount of pipe was coiled and welded, it was then telescoped out to its intended shape, as shown in Figure 2. Welded supports, braces, and connections were then completed for installation. There are something over 600 feet of pipe in the three coils shown.

Flash Welding Transformer Cases

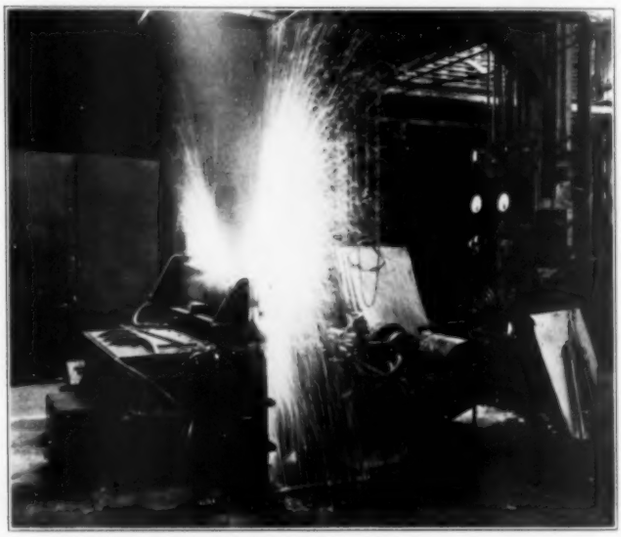
By H. W. Tobey†

Welding as a means of fabricating steel tanks for distribution of pole type transformers provides one of the most spectacular and interesting of operations. In the preparation of the casing or body of the tank, the copper bearing welding quality sheet steel sheath is cut to a specified size and while still flat is perforated with the necessary openings for primary and secondary bushing outlets, cooling tubes, etc. It is then thoroughly cleaned in an automatic sandblasting machine and finally rolled into cylindrical form. It is now ready for welding. It is placed in a heavily constructed welding machine of special design and the edges securely held between dies which are in turn supported in matted clamping members to prevent slipping. Upon application of the current a

†*General Electric Company, Pittsfield, Mass.*

tremendous shower of brilliant sparks flows from the machine and the effect is at once startling and beautiful.

The tank clamped as it is in the machine is rigidly supported and is provided with plenty of contact service for carrying the current from the low voltage winding of the welding transformers into the adjoining edges of the tank casing. The dies and clamping members holding one side of the tank sheath are stationary while those holding the opposite side are movable and operated by cams. This action



Flash Welds in Transformer Cases Are Rapidly Made.

is obtained from the power motor through reduction gears. Once clamped into position the machine is started through push-button control. The abutting edges approach each other at a carefully predetermined rate and as the minute projections come into contact first at one point and then at another, a terrific arcing or flashing takes conditions and under a veritable shower of sparks thrown high in the air above the machine, the adjoining edges become quite hot and assume a plastic condition. A rapidly accelerated rush of current now takes place while at the same moment the current which has assumed a value in the order to from 100,000 to 200,000 amperes depending upon the size of the tank is shut-off. Upon completing the cycle which extends over the period of a few seconds, the edges of the casing become solidly forged or flash-welded together.

All that remains to be done is to remove the flash or such metal which has been forced out along the line of the weld and the casing is then ready for assembly with base and rim. As this stripping operation is performed on a high speed machine designed especially for the purpose, it cleans both inner and outer surfaces in a single operation. The weld in strength, density, and oil tightness is equal to the rest of the casing and is not disturbed or injured by future forming operations.

All-Welded Steel Gear Blank Developed by Lukenweld

Lukenweld, Inc., of Coatesville, Pa., (division of Lukens Steel Company) which is primarily engaged in the design and manufacture of welded steel assemblies for machinery and equipment, has developed and is now manufacturing all-welded rolled steel gear blanks for use in the manufacture of cut gears. This gear blank is the culmination of a considerable period of research and experimental work, and patents on the blank have been applied for by Lukenweld, Inc.

The welded steel blank, which can be employed in the manufacture of spur, herringbone and helical gears, can be made any size from 24 inches outside diameter up. The largest all-welded gear blank made up to the present time is one with a shipping weight of 4,350 lbs. It is of 66¾ inches outside diameter, 11¾ inches width of face, 4⅛ inches thickness of rim, and 22½ inches diameter hub.

While the all-welded gear blanks are ordinarily made entirely from S. A. E. 1020 carbon steel, the rims can be furnished in steels of special analysis if desired.

The hubs of the all-welded gear blanks are first gas-cut from solid rolled steel of the thickness to give the desired hub diameters. The webs are gas-cut from rolled steel plate, as are the ribs, the latter being formed into channels of the required section. The webs are arc welded to the hubs, and the reinforcing channels are welded to the web structures. The final operation consists of the circular bending of the gear ring, and arc-welding in position to form the finished gear blank. Before shipment, all of the welded gear blanks are carefully and thoroughly annealed, under pyrometric furnace control. Welding operations are under rigid procedure control and in accordance with insurance welding practice.

In the manufacture of all-welded gear blanks, no patterns are required, as the gas-cutting and arc-welding are done with blueprints of the gear design as the guide. This feature, in addition to elimination of the pattern cost, permits prompt manufacture and shipment, since no time is required for pattern-making. This time-saving is an important advantage in filling requirements occasioned by gear breakdowns.

The major advantages of the all-welded gear blank, from the standpoint of both the gear manufacturer and the gear user, are the purity and homogeneity of the thoroughly-annealed rolled steel from which the gear blanks are made.

Lukenweld Steel Gear Blank.

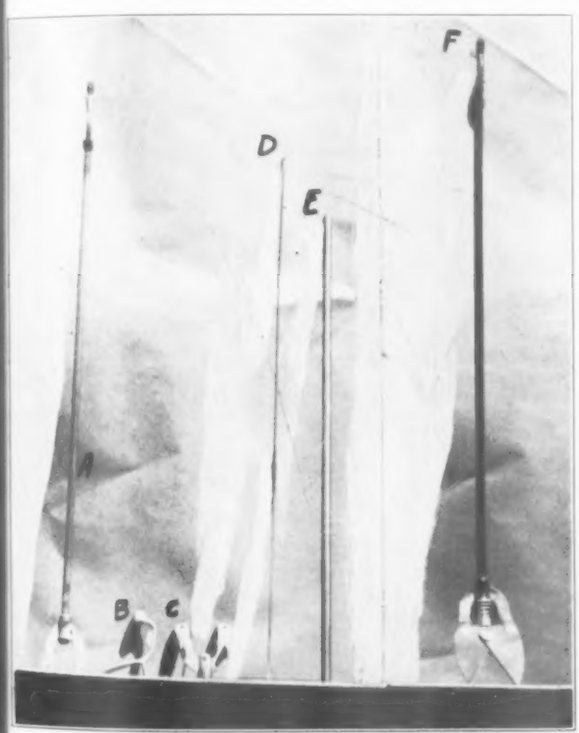
Rolled steel, as is well-known, is characterized by marked freedom from blowholes, gas pockets, hard or spongy spots and other defects. The gear rings, therefore, can be uniformly cut, and the cut teeth are sound in structure. These features minimize the losses of machining time, labor and gear material which might otherwise be caused by defects in rings discovered only after considerable cutting work had been done, frequently causing the scrapping of partially-cut gears. Moreover, the life of hobs and other gear-cutting tools is said to be increased because of the tendency towards less wear in cutting on sound and homogeneous rolled steel.

Hints for the Welder

WHEN YOU FIND a new way to do a hard job, or finish a particularly interesting weld, can you describe how the work was done? . . . . . Have you learned some little stunt every welder ought to know? . . . . . Write to us about these things . . . . . This department helps you welders to help each other. Write up your ideas any old way and just make rough pencil sketches . . . . We'll fix them up for publication.

100 Brazed Joints an Hour Possible With Proper Setup

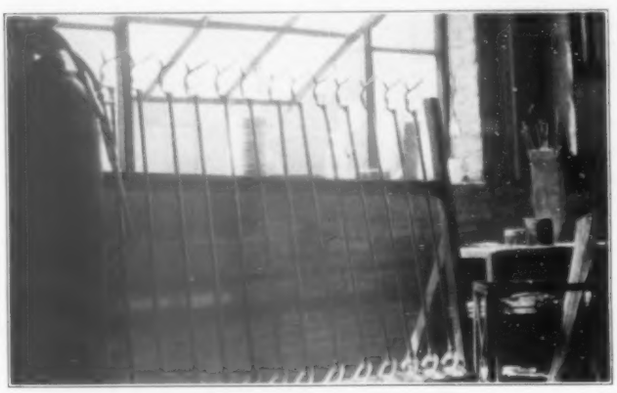
A short time ago The Chicago Cutting Die Corporation, 2333 Nelson Street, Chicago, Illinois, who manufacture a varied line of metal products in addition to cutting dies, placed on the market a new item for which there is a strong demand at this time of the year. This is a grass cutter for



"A," Tubular Shaft with Castings Brazed On; "B," Handle; "C," Fork; "D," Hook; "E," Shaft; "F," Complete Fork.

use in trimming grass in places which cannot be reached by the lawn mower. The device is very simple in its construction, consisting of a pair of shear blades, operated by means of a handle on the end of a shaft. This makes it possible to do the trimming of the lawn in a standing position. So great is the demand for this handy tool that the factory has been fairly swamped with orders and it has been necessary to use every means to speed up production so as to make the best of the market created by the coming on of the summer season.

The working parts of this tool are a pair of flat shear blades, a lever operating handle and a strip of high carbon steel passing from the shear blades through a small steel tube to the handle. The fork which holds the shear blades and the stationary part of the grip of the handle are castings. These are fitted over the ends of the steel tube and brazed in place. The strip which connects the shear blades with the movable lever in the handle is simply run through a hole in



Production Rack with Assemblies in Place. This Arrangement Makes for Speedy Work.

the lever, turned over, then formed into a solid knob by means of drop of bronze.

In order to speed up production a rack was made of 1"x 1"x⅛" angle iron so that a dozen of these assemblies could be set up in a row at one time. The operator makes the braze first on the top connections, using city gas and oxygen and a new city gas and oxygen brazing torch recently developed by the Torchweld Equipment Company of Chicago. After the top row of joints is completed he sits down and brazes the bottom joints. With this convenient arrangement a production rate of fifty complete assemblies per hour is easily maintained. The same equipment is used for making the bronze knob on the strip, or hook as it is called, except that in this case the speed is very much higher because it requires only a couple of seconds to make the small bronze knob on the end of the hook.

The brazing process is used for the fabrication of the tubing and casting into a complete unit because the bronze filler rod is so well adapted to making joints between different metals and because it makes a joint of sufficient strength with the use of the minimum amount of heat and time. It is the sort of an assembly which the manufacturer can easily guarantee for an indefinite period and at the same time assures a very low production cost on an article for which it is a simple matter to stir up a large demand.

Hotel Engineer Finds Use for Hard Surfacing

How the hard facing process is being used in a large modern hotel is related in a recent issue of *Oxy-Acetylene Tips*. Refuse coming from the kitchen is dumped into cans which are slid over the concrete floor of the basement.

These cans are of heavy gauge sheet steel, about 3 ft. high and 2 ft. in diameter. The abrasive action of the concrete on the heavily laden cans as they are being hauled about limits their life to about 8 months. At the end of this time, the steel has been worn so thin on the bottom that leaks develop and the cans have to be scrapped.

The chief engineer, an ardent believer in oxy-acetylene welding, first tried to remedy this situation by welding a heavy steel ring to the bottom of the cans. While this increased their length of service considerably, the added weight made them clumsy and unwieldy, so that this procedure was finally abandoned.

He then tried the Haynes Stelliting process and obtained remarkable results. Haynes Stellite was applied at three equidistant points on the bottom of the can in a band 6 to 8 in. long, ½ in. wide, and approximately $\frac{1}{16}$ in. thick. The first can was Haynes Stellited over three years ago, and today the hard facing material is but slightly worn. It is apparent that this can will last several years more and may at the end of this time be re-Stellited.

It was also found that much less effort was required to pull loaded cans across the concrete floor, because the hard facing material is inherently hard and takes a very high degree of polish, with the result that resistance to friction is considerably reduced.

How the Welder Can Do Safety Work

In their booklet entitled, "Safe Practices Pamphlet No. 41," on the subject of "Hand Tools," The National Safety Council provides some interesting discussions of accidents in which only the simplest kinds of hand tools are involved. Some idea of the important of this subject may be gathered from the fact that the Bureau of Statistics of the New York Dept. of Labor report 7,389 persons having received compensation in one year for injuries received from hand tools. The total amount paid for loss of time from work being over one and a half million dollars. The pamphlet contains a number of illustrations showing both unsafe and safe practices and among other things are shown a number of safety measures which can be accomplished by using the welding torch. Fig. 1, for example, shows a sledge hammer used in the plant of a large cement company. Each of these sledge

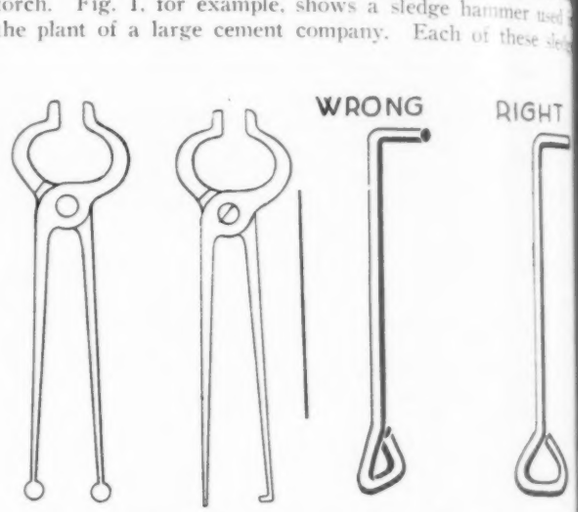


Figure 3. When the Ends of Tongs Are Upset on an Angle, Fingers Do Not Get Pinched. The Hooks (Right) Show the Right and Wrong Method of Construction.

hammers has a wrought iron strap clamped to the handle with two small bolts. The strap runs completely around the hammer head and is welded to it at the sides. Fig. 2 shows a variety of well constructed and efficient knife guards used by meat packing plants. A glance at the illustration will indicate that such guards can easily be made up by using the cutting and welding torch and scrap material. This is an excellent job for the man who is handy with the torch in cases where there is a demand for only one or two such guards.

Fig. 3 shows two methods of fixing the ends of tongs so that fingers cannot easily be pinched. These are jobs which can be done in a few moments with the torch and a hammer. In the same illustration are shown two methods of making an iron hook. The method on the left shows a hook which will invariably fall with the hook end up when it is dropped on the ground. It is things of this sort which cause accidents. To the right is shown a method of shaping the hook so that it will always lie flat when it is dropped. A hook which has been made wrong can easily be twisted into the correct shape by heating with the oxy-acetylene torch. The bulletin referred to is one which should be in every shop where hand tools are used as it contains a lot of splendid information regarding simple things which cause expensive accidents.

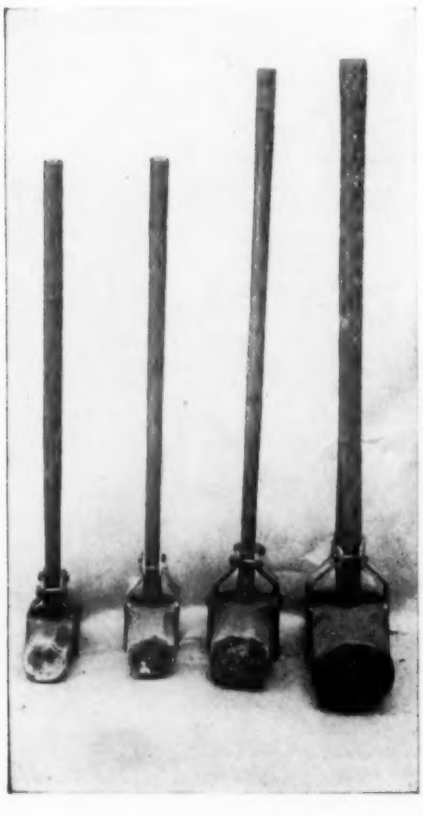
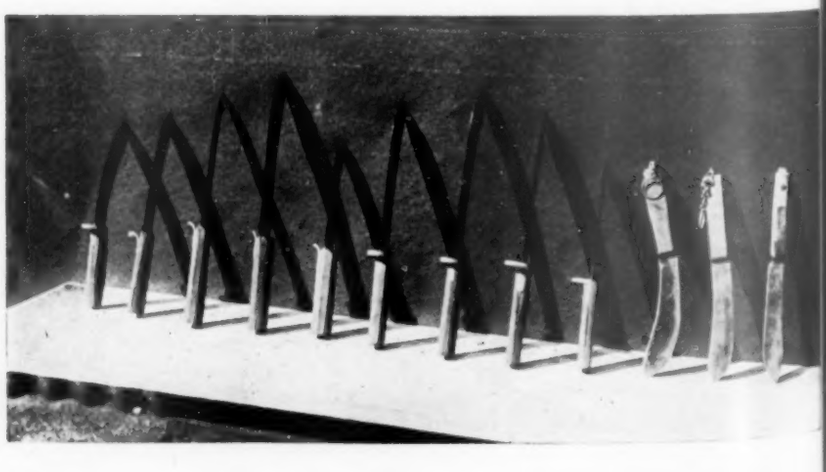


Figure 1. (Left) Sledge Hammers with Wrought Iron Straps Bolted to the Handles and Welded to the Heads. Figure 2. (Below) An Unusual and Well Constructed Variety of Knife Guards Made with the Welding Torch.

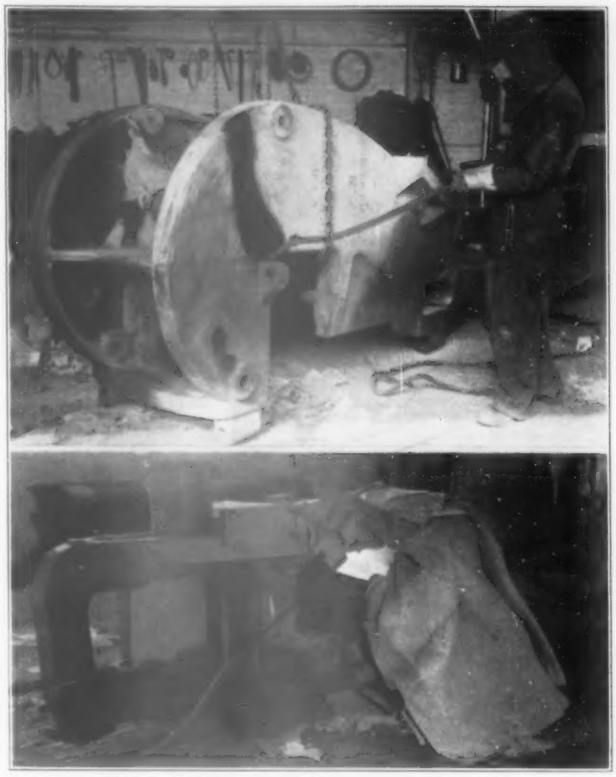


Safety Is Secured By Fillet Welding

Every once in a while evidence is forthcoming that design engineers are just as apt to overestimate the value of riveted construction as they are to under-estimate the strength of welded construction. A good example is a job recently handled by a contract welding shop in the middle west. The elevator door trolleys in a large office building had originally been assembled by riveting; however, they had not been in service very long before the rivets began to shake loose and the elevator doors were beginning to get a little bit rickety. This is not a good situation in a public building, or for that matter in any kind of a building, where elevators are in operation. At first it looked like a mighty expensive replacement job for somebody, but the proprietor of a job welding shop learned of the situation by accident and pointed out that a few inches of fillet welding on each trolley would make them perfectly rigid and strong enough to last as long as the building would last. It required only a simple test to prove that a welded job would be ideal for this purpose, so the contract was let. The welder got at the job by riding on top of the elevator cage and in this manner was able to make one shaft at a time and go through the entire elevator installation in short order. This contractor now has a definite experience to point to when people ask him: "Is welding safe?" and his reply is that "welding is safer."

Carbon Arc Used to Repair Punch Press Frame

An interesting heavy repair job was recently completely in the shop of the Western Welding & Boiler Repair Company, of Chicago. This was a broken punch press frame, weighing about 4 tons, which had broken through the throat. The crack was approximately 20 in. long and the metal chipped from the crack ranged from 1 to 8 in. thick. This job was preheated with city gas and charcoal for about four hours before welding was started. The base metal was then burned out in the vicinity of the crack, using the carbon arc.



The Method of Making this Carbon Arc Weld is Shown Above. The View Below Indicates How Preheating Was Accomplished.

An 800 amp. machine working at full capacity was used on the job and the crack was welded by the carbon arc process using cast iron filler rod. The job required 6 hours of welding time and 100 lbs. of filler rod. The casting was carefully covered after the weld was completed and 10 hours time allowed for cooling. It was estimated that 120 cu. in. of weld metal were deposited. No finishing was necessary because there were no machined areas involved.

Building a Job Welding Business

By W. Irving Brockson

IV—Use of Advertising Signs

THE first step in "telling the world" about your business is good signs on your shop. And by "good," in this case, is meant signs which are clear and legible, which can be read from long distances and which, in a few words, tell the name of your company and the kind of work you do. The words used, in addition to the firm name, should be very carefully chosen because they announce to all who read the kind of services you can render and it is important that they convey the correct impression.

Hire a Sign Painter

In going about the country one is impressed by the many "Home-made" signs on welding shops. You may be a first class welder and a good shop operator but the chances are you are not also a good artist. It is economy in the long run to hire a professional sign painter to put the display lettering on your building rather than to use "Home-brew" signs which you paint yourself. Remember that the signs on your building are going to last a long time and that every day of the year,—Sundays, holidays and St. Patrick's Day—they will be seen and read, giving impressions to passers-by, many of whom are customers and prospects. If these people see sloppy, bedraggled, school-boy signs, they are likely to think that the welding you do is in the same class. On the other hand if the signs are clear, neat and well done, your prospects will, consciously or unconsciously, receive the impression that your shop is up-to-date and capable of turning out good work. At least, the first impression—which is mighty important—is a good one.

Importance of Elevation

Signs placed high up on a building, of course, are more likely to be seen from a greater distance than ones placed low down. Consequently, it is well to locate the signs at as great an elevation as practicable. If there is a water tower, cupola or some similar high projection on the building, you would do well in most cases to use it as the base for a sign.

If no other buildings immediately adjoin yours, or if yours is higher than the neighboring ones, the side walls should be painted and lettered. Assuming that your shop is located near the center of the block on a street which is completely

built up and that your building is entirely hidden at the sides by neighboring buildings, it is a mistake to have only one sign painted on the front wall of the building. Such a sign has some slight value at short distances, but one has to be almost in front of it before the wording is readable. In such a location it is far better to have a suspended sign, constructed of wood or metal, out over the sidewalk, crossing the walk at right angles, because such a sign can be seen for a block or more away, depending upon the size of the letters.

"Left to Right—Not Upright"

A word or line which reads from left to right, like the printing on this page, is far more easily read than one which reads from top to bottom. Psychologists tell us the reason for this is that the human eye is so built that it can move with great speed from side to side and carry an impression to the brain as it goes, but it is not built to move up and down nearly so rapidly. You can prove this to your own satisfaction by reading Figure 1 and then Figure 2.

Brevity is Effective

It has been said, "Brevity is the soul of wit." It might also be said that brevity is the first requisite of a sign. Don't make the mistake of trying to crowd too much information or a great number of words into a display sign. The more words the smaller each must be, and consequently the shorter the effective range of the display. Your sign is for "flash" reading and should be designed to "drive home" at a glance your name and a statement of the kind of business you do.

A Tip from the Bill Boards

The outdoor advertising people are past masters at "sign advertising." You will immediately recall what huge bill board space is ordinarily taken up to present a half dozen words. And herein lies a tip for you.

The following are some suggested wordings, which are "old as the hills" and are not intended to be "clever." However they are business-like and may present a thought you can use.

FRANK WILSON
Gas, Electric Automatic
WELDING

FRANK WILSON
Everything Known in
WELDING

FRANK WILSON
Welding and Cutting

FRANK WILSON
Gas
Electric **WELDING**
Automatic

FRANK WILSON
Welding Headquarters

Road Signs

With a small expenditure of money a very effective piece of work can be done in the way of placing road signs on the important highways in the territory logically belonging to your shop. Costs and conditions vary so much from one part of the country to another that a detailed discussion of materials and expenses is not practicable here. Such signs can be made of a variety of materials—wood, glazed card board, metals, etc. The important thing is that they be durable, follow out the principles of brevity and arrangement mentioned above and that they be placed at points of much travel. The matter of readable address is important in this case. The principal element of value in such signs lies in the fact that the highways are used by a large percentage of the people in any community and if you have, for example, twenty-five signs placed at important intersections or other strategic roadside locations, most of your prospects, according to the laws of chance, will see one or more of these displays several times during a year.

Automobile Signs

If the business requires a truck, full advantage should be taken of it for good signs. Place the wording as high on the frame or body as practicable so it can be seen from as great a distance as possible and be least obstructed by traffic. Moreover it is a good plan to have the firm name over the driver's cabin at right angles to the direction of travel, so that it may be seen from the front and rear.

The shop manager's personal car may be "pressed into service" as a means of placing the company name before the public. If the good wife objects to riding on Sundays as

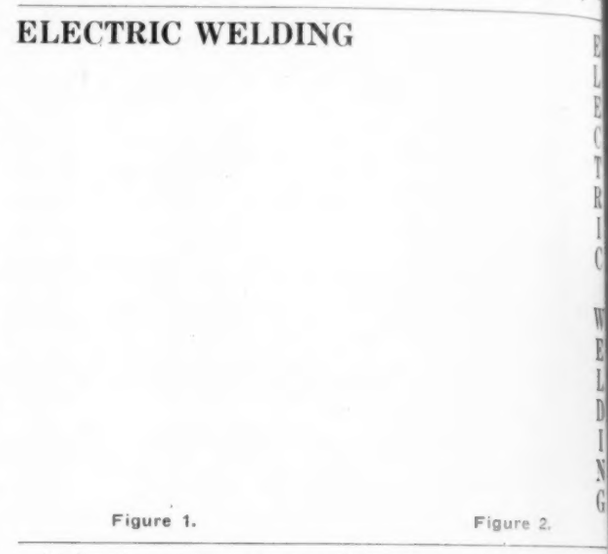


Figure 1. Figure 2.

a "painted wagon" a sign can be placed on leather and provision made to clamp it on the side of the car during the week and remove it on Sunday.

Auto Tire Covers

There are concerns which sell automobile tire covers painted to order for a reasonable fee, particularly when taken in quantities of a dozen or more. One lettered tire cover kept constantly on the passenger car of the shop owner is bound to be seen and read by hundreds of people. If a dozen or more covers are distributed gratis to automobilists who use their cars extensively in the shop's logical business area, the amount of publicity obtained is bound to be significant.

Windshield "Stickers"

Another effective type of sign is made to glue onto the windshields of autos and trucks and on the rear windows of passenger cars. A few of these "stickers" used by vehicle drivers who are friends of the shop manager will serve in the same capacity as the painted tire covers. Signs of this character have a particular value when placed on truck windshields owing to the fact that trucks ordinarily go in and out of the yards and shipping departments of large and small plants and usually are seen a great deal by foremen, receiving clerks and other men associated with production—men who should know about the welding shop advertised.

Signs for Publicity

Perhaps all of the types of signs enumerated above cannot be used by any given welding shop, but every shop can and should use more than one kind. Signs must be looked upon as a necessary part of a general plan of publicity intended, first, to educate people that the shop exists and, second, to keep them reminded of it and its services. When a shop first begins business, it is important to use as many means as the capital of the management will permit to acquaint people with the business. Furthermore, no shop, even after it has been established for years, can afford to ignore the publicity factor. The public forgets very easily and the old saying, "out of sight—out of mind," has a lot of truth in it with regard to a business as well as persons.

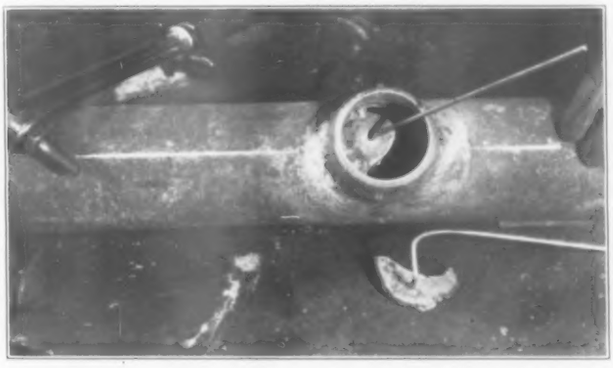
Make Signs Last

The extent to which you as a business man "believe in signs," very closely parallels your ability to sell the services of your shop from year to year. Be sure that signs will last long enough to be worth their cost. Colorless weatherproof varnish will prolong the life of many outdoor signs, and keep the "sparkle" of newness in them.

Weld Pipe Fittings Right On the Job

By Fred S. Durham†

Pipe welding, until recently, was limited to long runs. These installations were mainly used as low pressure carriers for liquids such as oil and gasoline and similar products and for transporting gases for illuminating and power purposes. The welding and laying of these lines were carried out under difficulties because there had been little or no development of welding fittings for making Tee's, Crosses, Side-outlet Tee's, etc.



Above: Center Lines Are Easily Located with the Fitting Which is Then Tacked in Place and Welded.

Left: After the Fitting is Welded in Place, the Button on the Inside is Cut Out in Two Sections. A Piece of Welding Rod Tacked on Each Piece Facilitates Removal.

Below: Welding the Branch to the Fitting Completes the Operation.

Now, industries everywhere are more and more realizing the decided advantages of welded piping, and this, coupled with the above, is of necessity creating a demand for welding fittings.

Bonney Forge and Tool Works, in December, 1930, showed at the Power Show at New York, two new products called Bonney Drop-Forged Weldolets and Thredolets. These products are welding fittings, designed to fill the need for making branch connections, such as Tee's, Side-outlet Tee's, Crosses, Double-crosses, etc. Very strong and durable branch connections are made with Weldolets or Thredolets, by merely tacking them to the parent pipe, then puddle welding along the Vee edge, cutting out the section of pipe inside the outlet of the fitting and, as the case may be, welding or screwing the branch in position.

The method of doing this formerly was to cut a hole in the main pipe, using a templet, then beveling the end of the branch pipe to fit the hole as nearly as possible. The branch was then welded to the main trunk and the junction completed. Naturally, there were some difficulties encountered in doing this accurately and in a satisfactory manner. Frequently the main pipe buckled or warped. In many cases the branch pipe did not fit closely, with the result that large quantities of welding metal had to be deposited at the line of junction; this did not make an economical job.

Weldolets and Thredolets are placed on the parent pipe in the exact location and at the angle at which the branch is to be taken. They are tacked and welded fast without disturbing the pipe. After the fitting is welded, an "S" shaped cut is made inside the outlet of the fitting. The heavy construction of the fittings prevents any distortion of the main pipe after the button has been removed. The funnel-shaped outlets reduce friction and turbulence when the joint is completed; and the "S" shaped cut permits removal of the button in two pieces.

An important feature is the beveled Vee edge along the surface of the Weldolet or Thredolet, which comes in contact with the parent pipe. This Vee edge brings the fitting in close contact with the parent pipe and allows the use of the most improved fusion or Vee weld, which, as is well known, is the strongest and simplest type of weld for this work.

These fittings allow a real flexible type of welded pipe construction. For example, a straight pipe, without disturbing it, may have welded on it at any angle from horizontal to vertical a Weldolet to form a right-angle branch. Opposite, or at any location on the other side of the pipe, may be placed another Weldolet to form a second right-angle branch. Thus an offset cross, or straight cross is produced. A third Weldolet may be introduced at an angle of 90° to this cross to form a side-outlet cross. Opposite this may be placed another, either in line with the above fittings or offset from them. In other words, Weldolets or Thredolets may be placed

in any variety of sizes or number of offsets along the main pipe, and consequently an unusually large combination of outlets provided.

Considering Thredolets, there are many situations where a fitting of this type is needed and valuable, as in heating and plumbing work, where branches for showers and hoppers are

†Vice President and Treasurer, Bonney Forge and Tool Works

These Two Views Show Completed Branches Made with the Weldolet (Left) and the Treadolet (Right).

necessary. Their threaded outlets also make a convenient fitting when placed on a line where their immediate employment as outlets is not necessary, or where the openings must be plugged temporarily for later use as a branch.

Full application for patent coverage for these products has been made. Trade-mark registrations have already been granted and they are now in production. A new bulletin has been prepared which describes and illustrates the wide ranges of sizes being produced.

Oxy-Acetylene Welding on Locomotives

There follows interesting exerpts from a paper recently read before the Portland, Ore., Section of the American Welding Society by F. L. Huggins, Supervisor, Applied Engineering Department, Portland District, Air Reduction Sales Company.

WELDING TIRES

A major problem in the machine shop is building up sharp flanges or flat spots on driving tires. Considerable trouble has been experienced from the effects of these operations, and some railroads have discontinued both of them because of the number of broken tires resulting from built up flanges or spots. The I. C. C. inspectors often frown on the operation because of the number of failures throughout the country.

Let us see if we can learn the reason why tires break after being worked on with a torch. When the tire is ready to put on the driving wheel, it is expanded by heat and placed on the wheel in an expanded condition. The contraction which takes place as the tire cools, holds it in position on the wheel. Of course, it is always under a tremendous strain, and when a torch is put to work on the cold tire, an additional strain is set up because of the uneven expansion and contraction. Often tires welded cold break in service after being welded. To overcome the possibility of breaking the tire is a simple matter. Before the welding operation is started, a tire heater is placed on the tire, and the tire is heated until it is loose on the wheel. The weld is made while the tire is in an expanded condition. Best results will be obtained when using two torches, but in case only one torch is used, it is sometimes necessary to use the tire heater two or three times in order to keep the tire expanded throughout the entire operation. If this is done, and the welding operation is properly carried on, there will be no breakage of tires due to building up with the torch.

WELDING WHEEL CENTERS

Another operation in the machine shop that has caused considerable trouble in the past is welding broken spokes or rims in wheel centers, especially cast iron centers. Cast iron wheel centers are not used on modern locomotives today, having been replaced by cast steel, but many locomotives now used in the logging industry still have the cast iron wheels.

It is almost impossible to preheat the wheel uniformly while on the axle, because of its upright position, the possibility of loosening the wheel on the axle, and the disastrous effect the heat might have on the appurtenances on the side of the locomotive. So, we must forget preheating and find a way to do the job cold. Assume, for example, that we have a cast iron wheel with four broken spokes adjacent to each other and the rim is solid without keys. The first step is to remove the tire; second, the rim should be split or cut in the center; third, the spokes veed out; fourth, a jack placed between the rim and wheel center; fifth, the break on the outside spoke spread or expanded 1/8 inch and welded with bronze rod.

When the weld on the first spoke is completed, and while still hot, the jack is removed and placed on the other side of the rim split or cut and the second spoke expanded similar to the first. This operation is repeated until all four spokes have been welded. After they have cooled, the jack is then placed in a horizontal position between the first two spokes near the rim and the rim expanded and welded. This procedure, we have found, is the best method of handling cast iron wheels on locomotives.

Welded Cooling Coils Work at 900 Lbs. Pressure

The manufacturer of the cooling coils shown in the accompanying photograph constitutes the principal business of the Acme Welded Pipe & Coil Company of Jackson, Michigan. This concern has been in the business of manufacturing refrigerating equipment, ammonia condensers, brine tanks and expansion coils for about fifteen years. Mr. R. C. Weatherwax is president, and C. E. Weatherwax is vice-president and general manager. The cooling coils illustrated are made for the S. E. Bloom Company, Chicago, who install this type of equipment in many theaters. The coil measures 10 ft. x

Arc Welded Cooling Coils for 900-Pound Working Pressure.

10 ft. x 24 in.; is arc welded throughout; has a low pressure and a high pressure side, and is capable of working under pressures up to 900 lbs. It is a patented design. The great difficulty in manufacturing the coil consists in securing perfect alignment between the tubing and the header. Although the heat effect is kept relatively low by using the electric arc, some strains are set up by welding, and these are relieved by heat treatment. Two years of experimental work were required to develop production technique which insured satisfactory work.

Different parts are first tack welded in position, the small coils being welded first and then the large assembly being

made. This pipe has a wall thickness of 3/16 in. An 1/8 in. electrode is used and the average welding time is three minutes per joint. Warping is prevented to a large extent by heating the side opposite the header at the time each weld is made. The entire assembly is tested at 1,500 lbs. hydrostatic pressure.

New Oil Well Drilling Device of Welded Construction

By the economical and practical use of welding, a new device, while still in its experimental stage, is being developed by the Texas Oil Company, at Signal Hill, California, and bids fair to bring about a great saving in the wear on oil well rotary mud pumps.

The accompanying photographs best describe the device, which is a cone-shaped tank or container about 8 feet high and 7 feet in diameter at the top, made of sheet metal and boiler plate. The purpose of this container is primarily for separating sand and cuttings of a gravel nature contained

Figure 1. The Outside of the Cone Welded from Scrap Sheet Metal.

in the rotary mud as it comes from the bottom of the oil well being drilled. By means of a special arrangement of an inner cone inside the large outside one, the circulation of the mud is retarded, thus allowing gravity to carry the sand and gravel to the bottom for removal and allowing the mud and water thus freed of the gravel, etc., to pass to the pumps to be returned to the well. By the removal of the sand from the mud an immense amount of wear on the bumps and hose, ordinarily experienced, is eliminated. This has always been a big item and a serious problem in oil well rotary drilling, pump failures always meaning expensive delays.

Figure 1 shows the beginning of the outside cone, which is constructed of old sheet metal of heavy gauge, and is of all-acetylene welded construction. Shaping and fitting the parts was done by the acetylene cutting torch. Three-inch pipe is used for the supporting legs, which are welded to the cone at the top and connected to the cone near the bottom by 2-inch pipe braces, as seen in Figure 2. The inlet through which the mud passes as it comes from the well is of 6-inch pipe and is welded into the cone near the top, as seen at the right in Figure 3. The outlet or overflow pipe, which is welded to and runs through both the outer and the inner cone, is of 8-inch pipe and is welded down and receives

Figure 2. The Cone Welded to Supporting Legs of 2-Inch Pipe.

the overflow from the center of the inner cone, as seen at the left of Figure 3 and also at the right in Figure 2.

This device, while still somewhat of an experiment, has indicated sufficient merit to warrant its use in a number of wells by the Texas Company, and its adoption is being considered by other companies who have seen it in operation. Only through the use of welding could it have been developed so practically, rapidly and economically. Thus again is aptly demonstrated one of the many ways that welding is aiding in the solving of problems in not only the oil industry, but practically every kind of industry.

Figure 3. Interior of the Welded Sand Cleaner.

J. C. McQuiston Retires from Westinghouse Company

J. C. McQuiston, General Advertising Manager of the Westinghouse Electric and Manufacturing Company, has announced his retirement effective June 1, 1931. Mr. McQuiston has been in charge of advertising for Westinghouse Electric for twenty-nine years, during which time that status of advertising and sales promotion and other allied phases of his profession have gone through as many changes as the electric industry itself. During his career, he has been responsible for expenditures totaling many millions of dollars in every form of advertising. As president of the Association of National Advertisers, and as a leader in association work in the electric and allied industries, he has an unusually wide acquaintance in the electric world. It is understood that in relinquishing his services with Westinghouse Mr. McQuiston will start on an extended cruise around the world with his wife and daughter.

Frederick M. Feiker Appointed to Department of Commerce

Frederick M. Feiker, since 1927 Managing Director of the Associated Business Papers, Inc., has been designated by President Hoover as Director of Foreign and Domestic Commerce, Department of Commerce, which is one of the most important bureaus in the government establishment. Mr. Feiker brings with him a great deal of experience with the work that he is now to undertake. In 1921, Mr. Hoover as secretary of Commerce secured the services of Mr. Feiker from the McGraw-Hill Publishing Co. for the purpose of developing the contacts of the Department of Commerce with business and trade. Among his activities at that time were assisting in the establishment of the Simplified Practice Divison and the organization of the Survey of Current Business which latter development has been given credit for doing much to forward statistical control of business.

"Autobiography of an Engineer" Book Review

"The Autobiography of an Engineer"—an interesting volume by Wm. LeRoy Emmet—has recently been published. The author is a graduate of the United States Naval Academy and was a navigator in actual service in the Spanish-American War. He collaborated in the development of the steam turbine and has been active in electric ship propulsion work. His most important invention is the mercury vapor turbine, the first unit of which is in successful operation at the South Meadow Station of the Hartford Electric Light Company, Hartford, Conn. Most of his life has been spent in Schenectady where he is known as one of the great creative engineers of the General Electric organization. The book is autobiographic, historical and technical. The account of the author's life is combined with descriptions of his work as engineer and inventor. It contains much of interest and value to engineers and much of inspiration to the younger generation of engineers. "The Autobiography of an Engineer" contains 213 pages, is well illustrated, and priced at $2.00 per copy. It is published by the Fort Orange Press, Albany, New York.

Many Technical Papers Ready for Boston Meeting

Sixty-five technical papers are on the tentative program of the annual convention of the American Society for Steel Treating which will be a feature of the National Metal Congress and Exposition in Boston, Sept. 21 to 25. This is a more than 50% increase over the number presented at the Metal Congress held last fall in Chicago.

The variety of subjects covered by the papers is correspondingly widened, according to Ray T. Bayless, assistant secretary of the Society in charge of technical activities.

Separate session devoted to melting sheet steel and nitriding are on the program, while the metallurgy of cast iron and nonferrous metals will also be covered.

Morning sessions of the Congress will be held at the Hotel Statler. Commonwealth Pier, scene of the National Metal Exposition, will accommodate the sessions scheduled for afternoon.

Flour City Oxwelding Company Equipped for More Business

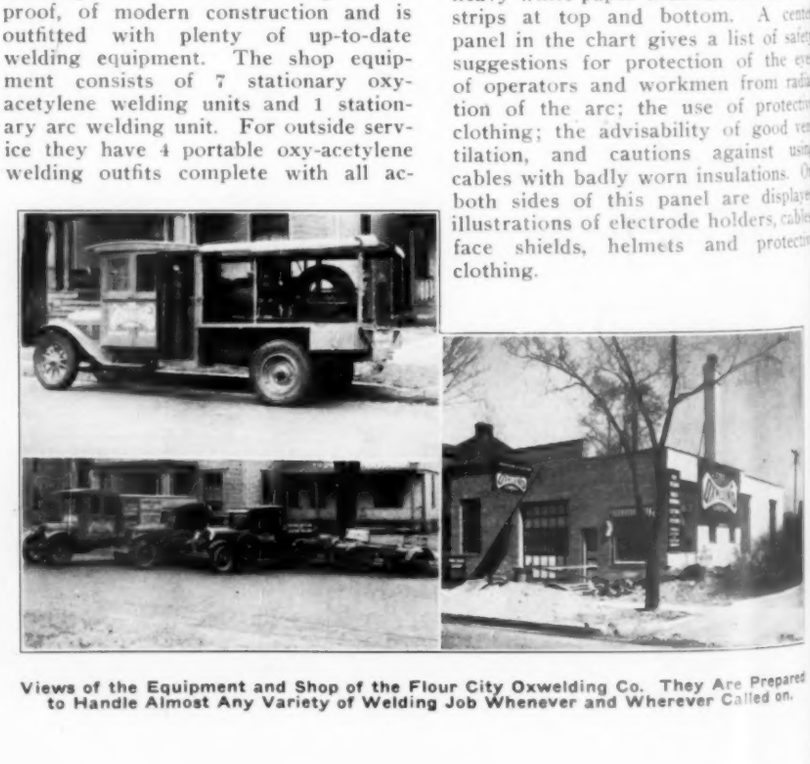
An increasing volume of business has made it necessary for the Flour City Oxwelding Company, Minneapolis, Minn., to expand its plant, and consequently the company has constructed a new building at 2937 Third Avenue, S., Minneapolis. The new building is fireproof, of modern construction and is outfitted with plenty of up-to-date welding equipment. The shop equipment consists of 7 stationary oxy-acetylene welding units and 1 stationary arc welding unit. For outside service they have 4 portable oxy-acetylene welding outfits complete with all accessories. There is one combination electric and oxy-acetylene welding outfit mounted on a 1½-ton truck which is a self-contained unit. The company claims that it is the most complete portable oxy-acetylene and electric welding shop on wheels in the northwest. The company has been in the welding business since 1919, and enjoys an enviable reputation for its progressiveness and the high standard of workmanship required of all operators.

Lincoln Safety Chart

Lincoln Electric Company, Cleveland, Ohio, have published a chart entitled "Safety First in Welding" for posting in shops where arc welding is done. This chart is approximately 2 ft. x 3 ft.

The Lincoln Safety Chart Keeps Safety Suggestions Constantly Before the Operator.

in size, printed in green and red on heavy white paper with reinforced metal strips at top and bottom. A central panel in the chart gives a list of safety suggestions for protection of the eyes of operators and workmen from radiation of the arc; the use of protective clothing; the advisability of good ventilation, and cautions against using cables with badly worn insulations. On both sides of this panel are displayed illustrations of electrode holders, cables, face shields, helmets and protective clothing.



Views of the Equipment and Shop of the Flour City Oxwelding Co. They Are Prepared to Handle Almost Any Variety of Welding Job Whenever and Wherever Called on.

Waukegan Welding Club Meets at Naval Station

The Waukegan Welding Club held its regular meeting at the Aviation Mechanics School, U. S. Naval Training Station, Great Lakes, Ill., Wednesday evening, June 3. Frank Hess, president, presided. The Club was conducted on an inspection trip through the school until the meeting opened at 8:00 o'clock.

The first speaker was Lieut. M. C. Faber, Supt., Aviation Mechanics School, who presented a constructive talk on "Character in Welding," which was followed by a talk by W. A. Slack, president, Torchweld Equipment Co., Chicago. Mr. J. L. Jensen of the same company, gave a short talk on "Use and Misuse of Oxy-Acetylene Equipment."

One of the features of the meetings of the club is the demonstration of various applications of the welding processes. On this occasion Mr. Thorpe, one of the members, demonstrated how cast aluminum should be handled with the welding torch, which was followed by a demonstration of sheet aluminum welding performed by H. P. Davidson, welding instructor at the Aviation Mechanics School. Ed Nelson of the Western Welding & Boiler Repair Co., Chicago, talked on cast iron cutting and then showed the assembly how his points are worked out in practice. This latter demonstration was one of the chief attractions of the evening.

The Waukegan Welding Club is an independent organization organized to further the uses of welding and aid those interested in the process to apply it to better advantage. Its meetings are always well attended—there were 130 present at the last gathering. Regular meetings are held the first Wednesday of each month with authoritative speakers and practical demonstrations. The officers are interested in hearing from anyone who can fit into their programs either as a speaker or demonstrator. They should get in contact with Frank Hess, president of the club at 917 Atlantic Ave., Waukegan, Ill.

R. E. Bruckner Joins Harris Organization

The Harris Calorific Co. of Cleveland announce that R. E. Bruckner, who for many years has been closely identified with the welding industry, has recently joined the Harris Calorific Sales Company of New York, with offices at 136 Liberty Street, New York City.

Mr. Bruckner's experience is long, wide and varied. His many friends located in every state in the Union will recall that in the early days, in addition to having designed torches and items used extensively in the oxy-acetylene welding and cutting industry, there were locomotive headlights, buoy lights and signals, acetylene installations on some of the most palatial privately owned yachts, all to Mr. Bruckner's credit. Mr. Bruckner in 1908 was the Chief Engineer of the Commercial Acetylene Company and was instrumental in pioneering the dissolving of acetylene gas in high pressure cylinders. His experience in this connection covered the installation of many plants for generation, purification, drying, charging and acetoning. From 1913 to 1928, Mr. Bruckner acted as Sales Engineer for the U. S. Gauge Company, and through this connection contacted with many apparatus manufacturers in the United States. From 1928 until recently, he served in a similar capacity for the National Gauge and Equipment Company.

In selling the new line of "Harris" welding and cutting equipment, Mr. Bruckner finds that the advanced design,

United District Heating, Inc., Enlarges Facilities

United District Heating, Inc., has purchased the plant and equipment of the Welding Metals Mfg. Co., located at 4400 Perkins Avenue, Cleveland, Ohio. For the past twenty years, the latter company has conducted a commercial welding business at this location, and this business will be continued by the new owners.

The entire second floor of the building at 4400 Perkins Avenue has been remodelled to accommodate the general offices of United District Heating, Inc., which were formerly located in the 71st-Euclid Building. The general administration and engineering departments of the company will be located at this new address.

United District Heating, Inc., was organized early in 1929 as engineers and contractors for the construction of pipe lines. Shortly after, it purchased the equipment and business of the underground piping department of The Collier Construction Company. While the company is equipped to handle any kind of piping projects for the transmission of steam, oil, gas or other fluid, its specialty is the design and installation of district heating systems which heat large areas and groups of buildings from a central source.

This organization has encountered and mastered many welding problems. A force of skilled mechanics has been developed within the company. At 60 Cherry Street, Akron, a complete welding plant is serving the industries of that community. With the acquisition of the plant of Welding Metals Mfg. Co., there becomes available to the users of welding in the Cleveland area a corps of welding artisans equipped with modern tools and apparatus, and backed by an engineering organization with scientific knowledge and wide experience. In these plants is a trained force for performing any of the usual applications of the oxy-acetylene flame, electric arc, and thermit processes, together with the more recent developments such as atomic hydrogen and the Hansen arc flame.

E. R. Benedict.

H. H. Snyder, the former owner of

NEW GENERAL ELECTRIC PLANT IN CLEVELAND

The 1,000 tons of welded steel framework is practically finished for General Electric's latest $1,000,000 plant in Cleveland. The main plant is 323 feet wide and 412 feet long, and will be used for making wire filament for incandescent lamps and for the manufacture of all gases used in the works of the National Lamp Co. The Austin Co., engineers and builders of Cleveland, is erecting the structure. The steel work was all fabricated and welded in the Austin mill near the General Electric structure, and represents one of the largest welding projects in American industry. The plant will employ 1,000 workers when operations start.

Welding Metals Mfg. Co., is retiring because of ill health, but the operating personnel of that company has been retained by the new owners.

E. R. Benedict, president and general manager of the merged companies, while employed by Air Reduction Sales Company some fifteen years ago, became much interested in the art of welding. Later, upon joining a national piping organization, he was one of the pioneers in promoting the method of joining lengths of pipe together by welding. Before coming to Cleveland,

N. W. Calvert.

he was connected with American District Steam Company and Northeastern Piping and Construction Company as construction engineer, and had charge of large piping projects in many cities of United States and Canada. Mr. Benedict is a graduate mechanical engineer, Syracuse University, and is a member of American Society of Heating and Ventilating Engineers and American Welding Society.

N. W. Calvert, secretary of United District Heating, Inc., has charge of sales and engineering. Mr. Calvert was formerly associated with The Detroit Edison Company, Detroit, Michigan, and Klipfel Mfg. Co., Chicago, for seventeen years. While with The Detroit Edison Company, he was loaned to the Rydro Electric Commission of the City of Winnipeg, Manitoba, Canada, to act as consulting engineer for the development of the city's district heating system. He also served in the same capacity for the Water and Light Commission of the City of Austin, Minnesota, and for several other municipalities. Mr. Calvert is a member of the National District Heating Association and of the American Society of Heating & Ventilating Engineers, and a past president of the Michigan chapter.

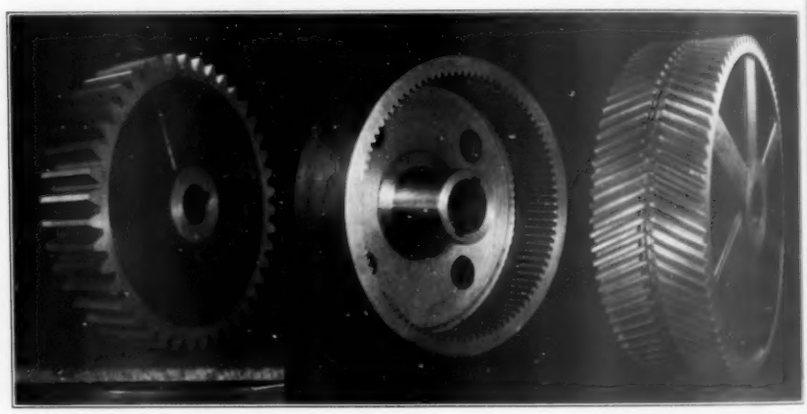
The U. D. H. engineering department is now working on several piping projects which the company has been commissioned to perform.

The superintendent of welding, in direct charge of the company's shops, is R. P. Palmer, who began his welding career fifteen years ago in the shops of the Pennsylvania Railroad. Later he entered the employ of Air Reduction Sales Co., and then went with the Nickel Plate Railroad as welding supervisor.

Assisting Mr. Palmer, and in charge of the Cleveland shop, is "Ed" MacKeown, who has acted in a similar capacity for the past ten years for the Welding Metals Mfg. Co.

A Complete Line of All-Welded Steel Gears

To meet the demand for heavy duty gears of greater uniform strength, longer wearing qualities, freedom from hidden blow holes and casting strains, Philadelphia Gear Works, Philadelphia, Pa., has developed a complete line of welded steel gears. These gears are claimed to have 50% higher tensile strength and to wear from 30 to 50% longer than cast gears in difficult service. The stock used is 1040 S.A.E. rolled steel plate. The rim is cut in the form of a solid ring with the gas cutting torch. A solid rolled steel disc forms the web of the gear against which channel shaped arms, die-formed from heavy plate, are welded to both sides. Either four or six arms are used according to the size of the gear. In the case of the smaller sizes, the web is strong enough to require no additional reinforcement. The hub is a forged steel bar drilled to receive the shaft. The hub, arms, web and rim are welded into an integral structure and then normalized before machining to insure permanent accuracy.



Three Types of "Philweld" Gears Manufactured by the Philadelphia Gear Works. Rolled Steel Fabricated by Welding Gives Longer Life and Greater Strength.

The advantages claimed for these gears, which are given the trade name "Philweld," are longer life and freedom from casting defects. The manufacturers state that they are approximately 10% lighter than cast gears. It is also pointed out that being constructed of metal which has a uniform density throughout they are naturally balanced. These gears are made in sizes from 15 to 168 in. and in spur, internal, helical, bevel, herring-bone, spiral bevel, and continuous herring-bone types. Heavy duty speed reducer units, equipped with these gears, are also available.

Pipe Line Welding in 1930

A News Letter of the International Acetylene Association carries the interesting information that one member of the association is advertising the fact that of the total overland pipe line mileage laid in 1930, 71.90% was gas welded. The News Letter also contains a complete list of the committees, and a complete list of the personnel of all the committees for 1931 which have been appointed by President W. D. Flannery—many of which have already met and have work under way. It appears that the membership committee has been particularly active, having announced 29 new members since the annual meeting which was held last November.

American Oxycop Headquarters Moved to Toronto

The American Oxycop Company, formerly located at 430 East Woodbridge St., Detroit, has been transferred to 117 Wellington St. West, Toronto, Canada. It is expected that the above company will very shortly open an office in Buffalo, N. Y., and a factory for manufacturing Oxy-Coal Gas Flame Cutting machines as patented by the Hancock Company, of Croydon, England.

Sales of these machines in the state of Michigan will be handled by the Bradley Machinery Co., 430 East Woodbridge St., Detroit, and for the states of Illinois and Wisconsin by the Scott-Bansbach Machinery Co., 4007 West 20th St., Chicago, Ill.

U. S. Steel Co. Publication on Stainless Steels

The United States Steel Corp. and its subsidiary companies have just published a 36-page book on the stainless and heat resisting steels of their manufacture. The products described are of the relatively low carbon type and divided into two general classes, i. e., chrome-nickel and chrome alloys. Of the former there are two classes designated as U S S 18-8 which is a general

purpose alloy finding a wide range of uses where corrosion resistance is desirable and the finished products are fabricated by some of the metal working processes. The second of this group is known as U S S 25-12 and finds wide use in heat resisting equipment. Of the straight chrome variety the first is U S S 17, a corrosion resistant steel for general requirements. Where corrosion resistant metal is desired for machined or forged parts, U S S 12 and U S S 12z are offered. The third of this group is U S S 27 which is both corrosion and heat resistant is offered particularly for the highest temperature work.

The book gives a complete discussion of all the physical and chemical properties of each of the metals and outlines the recommended procedures for using each, including such items as forging, annealing, welding, pickling, heat treating, etc. Many of the uses of each metal are shown in the illustrations.

Bulletin of Expansion Loop Design Data by Tube-Turns

There has just been issued by Tube-Turns, Inc., Louisville, Ky., a bulletin entitled "Design Data for Expansion Loops Made with Tube-Turns and Straight Pipe." As indicated by the title, the purpose of the bulletin is to furnish a convenient method of calculating expansion loops made up with Tube-Turns and straight runs of pipe. The most important part of this bulletin is a chart to aid in designing the loops so as to get them of a correct and convenient size to care for any given amount of expansion. The length of the run of pipe at the top of the loop or of the side legs can be limited to any construction requirements. The chart is constructed so that the maximum fiber stress in the loop due to bending will be approximately 16,000 pounds per square inch. The chart is applicable only to loops fabricated from low carbon steel pipe and fittings and to fittings having a radius of curvature of one and one-half times the nominal pipe diameter.

New Bulletin Describes Burke Arc Welders

Bulletin 901 A just issued by the Burke Electric Company, Erie, Pa., illustrates Burke arc welding generators from 100 amperes to 300 amperes capacity and gives a complete account of the electric and mechanical features of this equipment. Special attention is given to the method provided for adjusting the machine to deliver the right current for the work at hand. There is also a description of the frame construction, windings and commutators.

Lenney Issues Bulletins on Spot Welders

Two bulletins recently issued by the Lenney Machine & Mfg. Company, Warren, Ohio, describe several of the latest types of spot welders manufactured by that company. The first of these bulletins—No. 31—describes spot welders operated by foot power, and bulletin No. 32 shows automatic spot welding machines. A table in the last mentioned bulletin gives the required transformer capacity, the welding time in seconds, and the cost per thousand of spot welds when working with materials from 30 gauge up to 3 gauge.

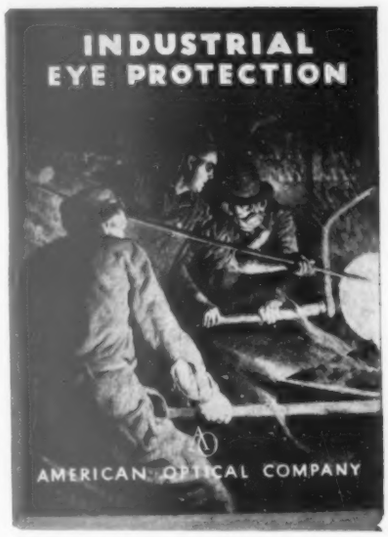
Two New Westinghouse Bulletins

The publication of a new leaflet entitled, FlexArc 600-Ampere Welder has been announced by the Westinghouse Electric and Manufacturing Company. This gas engine driven single operator welder is a heavy duty high speed welder designed especially for field pipe line welding.

A 16 page publication entitled, Westinghouse Arc Welding Data Bulletin No. 15, has recently been announced. This booklet contains illustrations of many unusual arc welding achievements, explains with the aid of diagrams various methods of testing, and discusses methods for obtaining good welds.

American Optical Co. Issues "Industrial Eye Protection"

The American Optical Company, Southbridge, Mass., have compiled and published a new edition of "Industrial Eye Protection," a reference catalog, containing their latest developments and recommendations for head and eye protection.



"Industrial Eye Protection."

The new catalog starts with a quick reference index to aid in quickly finding the type of protection recommended for the various kinds of eye hazards. In this respect the completeness of the line is impressive—particularly so because many improvements and additions have been made since the publication of their 1930 catalogue. The book has several other distinguishing points that deserve special mention. The front cover is one of them; it presents a most attractive illustration, in full color, of a scene drawn from life at one of the General Motors Foundries, and

The giant frame for a generator is being silently united into one solid piece of steel weighing 80,000 pounds, by means of electric welding, at the East Pittsburgh Plant of the Westinghouse Company. Sections, nearly the size of large automobiles form this frame. When the generator is completed, its output for one hour would keep the light in the torch of the Statue of Liberty burning for 435 years.

reproduced by courtesy of General Motors Corp. The pages devoted to discussions of eye hazards, the technical information, suggested uses of various types of protection, make this an interesting as well as useful publication to all concerned with industrial eye protection.

Hobart Bulletin Gives Details of Generator Construction

Bulletin G A W, just published by Hobart Bros., Troy, Ohio, gives six pages of description and illustration of the construction details of the Hobart arc welding generator. Several complete machines are shown together with

The Hobart Unitrol Panel.

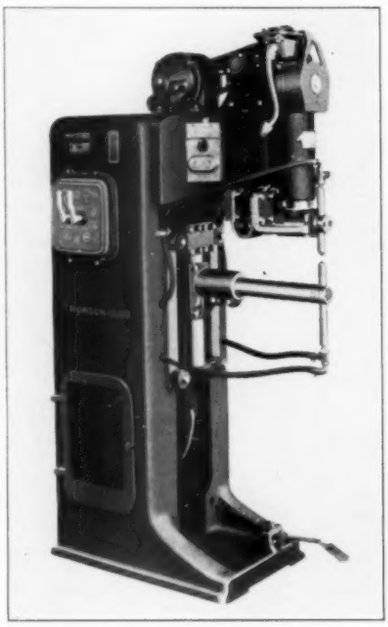
photographs of the single unit shaft also laminations, brush mountings, exciter and chassis. One page is devoted to a description of the Unitrol dial. This dial is shown in the accompanying illustration and is marked to indicate the current setting for electrode size recommended for welding metals of various thicknesses. Meters are located in the same panel so that the operator can read the voltage and current simultaneously. This control cabinet is mounted on top of the generator.

G-E Protective Paint Absorbs Ultra-Violet Rays

An improved paint for protection from ultra-violet radiation has been announced by the Merchandise Department of the General Electric Company. Developed particularly to absorb the dangerous invisible rays of ultra-violet light produced in arc welding, the paint is used on the walls and ceilings of rooms in which electric arc welding is being used. Better adhesion and no tendency to powder off the surface have been attained in this new, grey, oil-type paint. Petroleum spirits are used for thinning the paint, which dries in approximately two hours. The product has been designated as G.E. No. 881 UVR Protective Paint.

Thomson-Gibb Announces New Press Welder

A new press welder in a price range below one thousand dollars has recently been announced by the Thompson-Gibb Electric Welding Company of Lynn, Mass. This is a medium duty automatic spot and projection welder with smooth straight spindle press type action, which the manufacturers state adds greatly to the life of the machine itself and also of the electrodes. It is claimed that this machine will make welds with practically no discolorations or depressions. The design permits readily changing the fundamental characteristics of the machine at small expense; that is, if a user finds that he has need for a machine with a different throat size, different stroke and different speed, he needs only to order a few new parts and make the desired change. The parts removed can be stored and



Thomson-Gibb Medium Duty Press Welder.

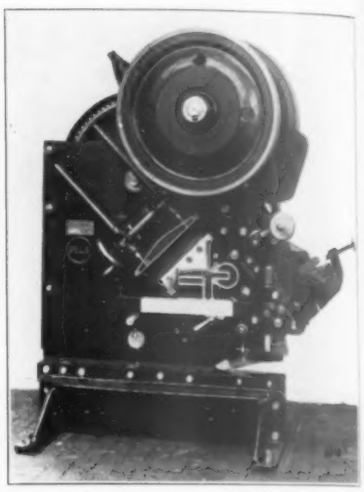
the machine changed back at will. The complete driving mechanism is all mounted on top which makes for economy in floor space and accessibility of all parts. The driving mechanism consists of a motor and worm reduction and a clutch unit. The motor drives the worm reduction and clutch by means of a roller chain. The worm gear pressure cam and welding current timing cam are all mounted on the same shaft. The transformer is water cooled and the design gives sixteen variations of welding heat. The machine is capable of developing welding pressures up to 900 lbs. A pressure scale is located in the head of the machine to facilitate the recording of correct pressure fittings for all jobs. Speeds from 30 to 160 spots per minute are available. A four speed motor and control can be furnished making the machine a four speed machine, several four speed combinations being available. Throat depths range from 12 in. to 24 in. and transformer capacity from 20 K V A to 40 K V A.

Crane Announces Varied Line of Welding Fittings

The Crane Company, Chicago, who are well-known as manufacturers of pipe fittings, have recently announced a varied line of fittings for welded pipe installations. These fittings include elbows and tees. Some are made of seamless tubing, and others are made of steel forgings welded together by the electric resistance method.

New Shear for Use in Welding Departments

Henry Pels & Co., 90 West St., New York City, have placed on the market a newly designed machine, in two sizes, for cutting angles, tees, round, square and flat bars, plates, and also for notching or coping. This machine, which is shown in illustration, does not perform punching operations.



The Pels Shear Which is Suitable for Preparing Shapes for Welding.

The smaler size machine will shear ½-inch plate of any width, while the larger one will shear ⅝-inch plate. The frames are of the guaranteed unbreakable steel plate construction featured by this company for more than 30 years.

New Paint Spray Equipment Announced by Imperial

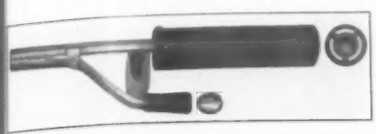
The Imperial Brass Mfg. Co., Chicago, has just announced a new and complete line of spray painting equipment. New principles of construction, with improved atomization, are incorporated in the new Imperial Paint Spray Guns which are made in a variety of sizes

Imperial Brass Paint Sprayer.

and types to meet a wide range of requirements. The Imperial line also includes compressors, air conditioners, liquid containers, gauges, hose, and every other accessory that goes to make the line complete.

Mattice Announces New Electrode Holder

Mattice Engineering Co., Inc., 2233 Nine St., Philadelphia, Pa., has placed on the market the Mattice air-cooled, non-heating, copper welding handle. This solid copper handle will not burn up, has approximately fourteen times



The Mattice Air-Cooled Non-Heating Electrode Holder.

the conductivity of iron or steel and doesn't get full of metal particles. The handle and finger tip are air cooled; the cable is soldered in. A feature is the oil-tempered volute spring; this cannot fall out and is covered by a rubber sleeve. Wire cannot slip as groves hold it securely. The handle weighs 1¼ lbs. and can be comfortably held by the welder in any position. Mattice Engineering Co. equips and installs electric arc welding sets complete.

Popular Priced Spotwelder Announced by A. E. F.

The American Electric Fusion Corp., Chicago, has designed a new spot welder expressly for the small sheet metal working shops, tinsmiths, etc.

This spotwelder, while primarily for thin gauge materials, has sufficient capacity for welding operation on 16 gauge galvanized steel to like gauges or

The A. E. F. Popular Priced Spot Welder.

sheet to angle frames, etc., for the making of guards and a variety of odd jobs encountered in any factory. It is priced at $175.00.

Connections are being made at the present time for distribution of this new equipment on a large scale. Some distributors are out-fitting salesmen's cars with a welding machine, and it is believed that the sale of this welder will evolve itself into practically a house-to-house canvass.

News of the Industry

E. L. Mills, sales manager, Bastian-Blessing Co., and president of the Gas Products Asso., Chicago, has an article "What if It Hadn't Happened?" which appears in the current issue of *Class & Industrial Marketing*. Mr. Mills discusses some of the problems that industrial executives have met in the past year and what his company has done to overcome them.

"USL Battery Corporation, manufacturers of USL electric arc welding equipment have just appointed the Commercial Iron Works, 171 Globe St., Providence, R. I., as their distributors for the states of Massachusetts, Rhode Island and Connecticut. The Commercial Iron Works have been fabricating metal for more than thirty years and their engineers are qualified to offer expert advice in connection with all problems dealing with the application of electric arc welding."

The current issue of *Wire Engineering*, publication of the John A. Roebling's Sons Company, has an interesting article on the welding of the Southern California Edison Building, in the construction of which Roebling electric welding wire was used. The article includes photographs of the completed building and close-up views of some of the welded joints, and comments especially on the advantages of welded assembly for many of the special connections in this building, which is said to be the strongest structure ever erected in Los Angeles.

The Automatic Arc Welding Company, New York City, report that the Babcock & Wilcox Company have recently acquired non-exclusive licenses under their automatic arc welding patents.

Some interesting arc welding jobs on cast iron are described by Mr. F. A. Green in issue No. 21 of the Fusion News which has just been published by the Fusion Welding Corporation of Chicago.

The Modern Engineering Company of Memphis, Tenn., has just announced the completion of a new acetylene plant at 1262 Tulley Street. The sales office and display room of the company will be continued at 353 Madison Avenue, Memphis, where complete stocks of equipment and supplies, as well as gases, will be stored. The new acetylene plant has an all-welded piping system, in which a number of Tube-Turns are used. It has a complete purification system of special design. All of the equipment, with the exception of the compressor, was built by the Modern Engineering Company at St. Louis, Missouri.

Bulletin AS No. 31 recently issued by the AllSteel Press Company, Chicago, Illinois, describes the Verson Allsteel line of arc welded steel plate punch presses. This bulletin describes the method of manufacture of these punch presses which is by arc welding of rolled steel and discusses the advantages of welded construction. Illustrations of various types of presses of this construction are shown.

The *El Paso Herald-Post* of June 3 tells all about W. J. "Bill" Chesak, one of the city personalities, who is long and well known to the welding industry. Bill is now with the Modern Engineering Co. of El Paso, Texas, which he organized on the first of January, 1930. We find out many things about Bill in this pictured account among which are that he was raised on a farm and attended the Wisconsin Conservatory of Music. His first job was selling pork chops and such in the butcher shop of his Uncle and a boyhood ambition to play a slide trombone. We now find him selling Meco welding torches and USL arc welders.

C. T. Price, manager of Gas Sales for the Burdett Oxygen and Hydrogen Co., Chicago, was one of the speakers at the luncheon meeting of the Advertising Men's Post, No. 38, American Legion, Chicago, June 1. Mr. Price talked on the properties of liquid oxygen and followed it with a demonstration.

Dr. Ancel St. John, president, St. John X-ray Service Corp., 505 Fifth Ave., New York City, has been appointed a member of the technical board of the Welding Engineering & Research Corp., 25 West 43rd St., New York City.

Elmer H. Smith, president, Smith Welding Equipment Corp., and Commercial Gas Co., Minneapolis, Minn., has written an article entitled "Welding Instruction for Undergraduate Engineers" which appears in the May issue of *The Minnesota Techno-Log*, publication of the engineering school of the University of Minnesota.

The Flour City Oxwelding Co., Minneapolis, Minn., have just completed the contract for pipe welding in the new thirty-two story Bank Building in St. Paul, Minn. This is said to be one of the largest steam heating jobs done in the Northwest.

Mr. F. M. Wyman has been appointed district sales manager for the Burdett Oxygen & Hydrogen Co. of Chicago. Mr. Wyman has had many years experience in the oxy-acetylene industry and prior to his appointment to this position was with this company in a sales capacity at Pittsburgh, Pa.

The Hamlett Welding Shop, 703 Bullard Street, Silver City, N. Mex., which is owned by Oxy Bill Hamlett, received a fine send-off in a recent issue of a publication called Southwest New

Mexico in Pictures and Prose. The item points out that this shop has been established for sixteen years and is experienced in practically every branch of welding, although it specializes in the welding of mine machinery, engines and automotive parts. Oxy Bill has been known throughout the Southwest territory for a good many years and it is no exaggeration to state that his welding shop is one which would do credit to any city in the country.

The branch welding shop of the Candee Iron Works of McKettrick, California, located at Bakersfield, recently changed to new management. The new managers are Carl Eggers, F. R. Candee, and O. S. Poler. The shop will be known as the Kern County Welding Co., and will feature general welding of all kinds, specializing on oil field service work.

The Williamson Welding Works, specialists in car starter fly wheel repair, with headquarters at San Bernardino, California, have recently opened a new branch shop in Salt Lake City, Utah. "Mac" McDonald is manager of the new shop.

The Steel Tank & Pipe Company of Berkeley, Cal., was recently awarded a contract by the East Bay Municipal Utility District of Oakland to furnish and deliver 6,000 feet of electrically welded sheet steel pipe.

The A. O. Smith Corporation of Milwaukee, Wis., has recently been awarded the contract for the pipe requirements for a 10-inch all-welded pipe line for the Ohio Oil Co. The line will run from the Dry Creek field in southern Montana to Bozeman, Mont. The pipe will be in 30-foot joints with double bell connections.

The Inland Iron Works Co., of Okmulgee, Oklahoma, recently purchased the Okmulgee plant of the United Iron Works, Inc., both plants of which do large amounts of welding. The general office of the Inland Company will be retained in Okmulgee, with sales offices in both that city and in Tulsa. The personnel of the United Iron Works will be retained.

The May meeting of the Los Angeles Section of the American Welding Society was held at the Engineers Club May 14th. Considerable discussion was given on the matter of a tentative code for the qualification of welders, which was proposed before the A. S. M. E. Boiler Code Committee.

The main feature of the evening was a very interesting talk by Major James Caldwell, M. I. E. E., of London, England, who is on a round the world tour for the purpose of inspecting welding activities in all possessions of the British Empire. Major Caldwell's talk covered some of his war experiences, the development of electric arc welding, and interesting applications of welding he had inspected in the course of his travels.

The Burdett Oxygen & Hydrogen Co. has entered the Milwaukee, Wis., territory and now maintains an office and warehouse at 150 West Fowler Street. Mr. Fred Huennekens, Jr., is local representative.

A contract was recently awarded for the construction of about 28 miles of gathering lines in the North Dome of the Kettleman Hills (Calif.) field. The work involved the construction of two complete lines, one of which will transport oil and the other will be for gas, to be produced from wells drilled by the Kettleman North Dome Association. The lines vary in different sections from 12-inch to 16-inch in size. Youngstown pipe was used for the lines, which was oxy-acetylene welded. The Macco Construction Company of Clearwater was awarded the contract for this job.

Prof. N. F. Ward of the College of Engineering, University of California, is lecturing on welding at the Oakland Airport, California. This work is in connection with instruction of future airplane mechanics who are pursuing the course at the Boeing School of Aeronautics. Prof. Ward's instruction deals with the theory and practice of gas, electric arc, and atomic hydrogen arc welding. His work started in the summer of 1929 when the course in welding for airplane mechanics was inaugurated at the airport. John Kleespie, formerly with the Douglas Company, is welding instructor, and W. E. Beall and H. L. Parr, engineers of experience in the aeronautical field, are instructors in design, drafting and engineering drawing.

The Arkansas Natural Gas Co. is constructing an eight-inch gas welded pipe line running from Shreveport to the company's production in the Gregg County, Texas, field. The line is approximately 70 miles long, about 50 miles of which is already welded and about 30 miles lowered and backfilled. Ford, Bacon & Davis, of New York, are the contractors in charge of the work.

J. M. Hanagan has recently been placed in charge of the welding work in the shop of T. M. Frew & Son, who own a machine and welding shop in Newhall, Calif. Mr. Hanagan recently returned from Phoenix, Arizona, where he had been engaged in pipe line construction work.

A new welding shop is opening for business at 525 Colorado Street in Glendale, Calif., under the ownership and management of John P. Schonborn. The new shop will be known as the Colorado Iron Works, and will feature general welding, repair work, and blacksmithing.

At the April meeting of the Australian Welding Institute, which was held on April 23rd, a paper on the subject of "Defects in Bronze Welding" was read by E. J. Raymond, and a paper on the subject of "Practical Repairs by Electric Welding" was read by Chas. Curtayne.

B. G. Gustafson, formerly with the Midwest Steel & Supply Co., Bradford, Pa., has recently been appointed works manager of the American Air Filter Co., at Louisville, Ky.

British rights to the atomic hydrogen welding process are held by Associated Electrical Industries, who have handed the selling rights to Murex Welding Processes, Ltd., London, in conjunction with and through Metropolitan-Vickers Electrical Company, Ltd. The Murex concern has recently issued a complete bulletin covering the principles and applications of the process.

The Association of Certified Welders, Tacoma (Washington), Local No. 3, has been organized by Ben L. Patton and Donald H. Watts. The principal object is to provide social meeting places for welders and helpers.

The Institution of Welding Engineers (England) has recently opened a northwestern branch to serve an area within a radius of approximately 50 miles of Manchester. Already there are over 80 members and applications are received daily. The branch was opened with a lecture on "The Use of Soft Iron Wire for Welding Cast Iron." Further meetings have been arranged, including visits to plants during the summer months. There is every prospect of a very active local branch.

N. G. Conley, welding and construction engineer, has recently returned from Russia, where he has just completed four years in oil refinery construction work. Mr. Conley reports that both electric and acetylene welding are used extensively in refinery construction work there. He says that the native welders are exceptionally good. All of the equipment used there is of American manufacture. Acetylene is manufactured in Baku. Mr. Conley, whose work was principally around Baku and Batum, expects to return in the near future and resume his work in that country.

E. L. Varney, construction and welding engineer for C. F. Braun & Co., Inc., San Francisco, Calif., has sailed for Burma to supervise the installation of two Braun constructed recovery plants in the oil fields near Mandalay. These plants are principally of welded construction, the main part of which is by the electric arc process. The Braun company have other plants in operation in Persia and western Asiatic fields, and also in Sumatra, Venezuela, Colombia, Argentina and Peru.

The Pasadena Junior College at Pasadena, Calif., is considering adding a course of welding instruction to their Manual Arts department in the near future. O. L. Heald is director of this department.

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Silicon Copper	1981°F
Phosphor Bronze	1922°F
Everdur*	1866°F

for arc welding	
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Phosphor Bronze	1922°F
Everdur*	1866°F

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ANACONDA WELDING RODS

Scott Brothers Well Drilling Co., of Moorpark, California, recently equipped their repair shop with both gas and electric welding equipment. F. C. Scott, one of the brothers, attended the Oil Equipment and Engineering Exposition recently held in Los Angeles. He anticipates the purchase of additional electric welding equipment in the near future.

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Welder-Blacksmith—With 12 years' experience. Desire a position anywhere in the United States. Address George Petrie, Ionia, Michigan.

Welder Foreman—15 years' in one plant, 7 as foreman. Experienced in arc, spot or gas welding any metal. Married, travel if necessary. A. Fischer, 1843 No. Keeler Ave., Chicago, Ill.

Arc Welder—Two years' experience in general, heavy plate, pipe and conduit welding. Single, willing to travel. Wm. Cunningham, 4216 West End Ave., Chicago, Ill.

Combination Welder—Gas, arc and spot welding experienc Can set up for spot welding, handy mechanic. Know sh metal, cast iron and brazing. 2 years' experience. Sing willing to travel. Lester Nelson, 1522 Diversey Blvd., C cago, Ill.

Combination—Four years' experience on pipe, production light and heavy work. Good recommendation. Single, wi ing to travel. Roy Jordan, 5509 So. Troy St., Chicago, Ill.

Combination—Fourteen years' experience on all kinds work. Expert on aluminum, alloys, tank and pipe work. J shop experience. Married, willing to travel. Geo. Gustafs 256 W. 33rd St., Chicago, Ill.

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Gas Welder—14 years' experience on sheet metal, light j shop work. Married, will travel if necessary. Jerome O'Lear 6234 Vernon Ave., Chicago, Ill.

Combination Welder—Fifteen years' experience in job sh and industrial welding. Experienced in taking charge of wel ing dept. Also in laying out own work from blue pri E. L. Heldt, 640 No. Lamon Ave., Chicago, Ill.

Position Wanted—As welding engineer or welding sal engineer. Have experience in design and production in bo arc welding and resistance welding. Understand installati and operation of automatic arc equipment. Age 31, go an where. Can furnish excellent references. Address Box 42 The Welding Engineer.

Structural Engineer and Sales Manager—Familiar wi structural steel and ornamental iron work. Desire to for a connection with a manufacturer specializing in, or wish to specialize in the manufacture and erection of structur steel and ornamental iron by welding methods. Would des to make some investment. Address Box 424, The Weldi Engineer.

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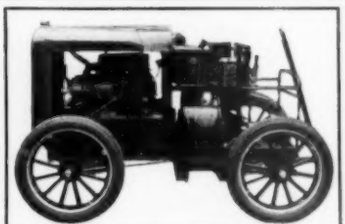

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